State of California
AIR RESOURCES BOARD

PUBLIC HEARING TO CONSIDER THE PROPOSED
INNOVATIVE CLEAN TRANSIT REGULATION
A REPLACEMENT OF THE FLEET RULE FOR TRANSIT AGENCIES

STAFF REPORT: INITIAL STATEMENT OF REASONS

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LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
AC Transit	Alameda-Contra Costa Transit District
ADA	Americans with Disabilities Act
AEO	Annual Energy Outlook
APTA	American Public Transportation Association
AVTA	Antelope Valley Transit Agency
BEB	Battery Electric Bus
CalACT	California Association for Coordinated Transportation
CalSTA	California State Transportation Agency
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CBA	Community Benefits Agreement
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CNG	Compressed Natural Gas
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CoEZET	Center of Excellence in Zero-Emission Technology
CPUC	California Public Utility Commission
CTA	California Transit Association
DAC	Disadvantaged Community
DGE	Diesel Gallon Equivalent
DMV	Department of Motor Vehicles
DOE	Department of Energy
DOF	Department of Finance
EA	Environmental Analysis
EIA	Energy Information Administration
ER	Emergency Room
EVSE	Electric Vehicle Supply Equipment
FAST	Fixing America’s Surface Transportation
FCEB	Fuel Cell Electric Bus
FTA	Federal Transit Administration
FY	Fiscal Year
GDP	Gross Domestic Product
GGRF	Greenhouse Gas Reduction Fund
GHG	Greenhouse Gas
GSP	Gross State Product
GVWR	Gross Vehicle Weight Rating

HVAC	Heat, Ventilation, and Air Conditioning
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher
IBEW	Brotherhood of Electrical Workers
ICT	Innovative Clean Transit
IOU	Investor Owned Utility
ISOR	Initial Statement of Reasons
JMA	Jobs to Move America
kWh	Kilowatt Hour
LA Metro	Los Angeles County Metropolitan Transportation Authority
LCFS	Low Carbon Fuel Standard
LCTOP	Low Carbon Transit Operation Program
Low-No	Low or No emission
MBTA	Morongo Basin Transit Authority
MMT	Million Metric Tons
MPO	Metropolitan Planning Organizations
MTIP	Metropolitan Transportation Improvement Program
MTP	Metropolitan Transportation Plan
NOP	Notice of Preparation
NOx	Oxides of Nitrogen
NTD	National Transit Database
O&M	Operating and Maintenance
PG&E	Pacific Gas and Electric
PM	Particulate Matter
RD	Renewable Diesel
RFS	Renewable Fuel Standard
RNG	Renewable Natural Gas
RTP	Regional Transportation Plan
SB	Senate Bill
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SCS	Sustainable Communities Strategies
SDG&E	San Diego Gas & Electric
SRIA	Standardized Regulatory Impact Assessment
STA	State Transit Assistance
State SIP Strategy	State Strategy for the State Implementation Plan
TAS	Transit Agency Subcommittee
TCO	Total Cost of Ownership
TIRCP	Transit and Intercity Rail Capital Program
VIN	Vehicle Identification Number
VMT	Vehicle Miles Travelled

VW	Volkswagen
WTW	Well-to-Wheel
ZEB	Zero-Emission Bus
ZEBA	Zero-Emission Bay Area
ZEV	Zero-Emission Vehicle

EXECUTIVE SUMMARY

Purpose of Proposed Rulemaking

California's efforts to meet its health-based air quality standards, address community needs, and fight climate change require a holistic approach and a comprehensive suite of measures to reduce emissions. The transportation sector is responsible for about 40 percent of greenhouse gas (GHG) emissions, 80 percent of oxides of nitrogen (NOx) emissions, and 90 percent of diesel particulate matter (PM) emissions in California. Broadly implementing zero-emission technologies is a necessary component to effectively address these multiple and complicated air quality and climate protection issues all at once.

Transit agencies are the state's partners in leading the way with heavy-duty vehicle technology innovations. They have played, and will continue to play, important roles in helping California meet air quality standards and GHG emissions reduction goals by deploying the cleanest technologies. Examples are demonstrated in the successful use of diesel PM filters and natural gas engines. Their leadership continues today with multiple transit agencies operating zero-emission buses (ZEBs) in regular revenue service, including both battery electric buses (BEB) and fuel cell electric buses (FCEB). Transit buses are well-suited for introducing zero-emission technology because they largely operate in urban centers, have stop-and-go driving cycles, and are centrally maintained and fueled. As of May 2018, there were 132 ZEBs in operation in California and an additional 655 are either on order, have been awarded for funding, or have been planned. Eight of the ten largest California transit agencies are operating ZEBs and 12 transit agencies have made commitments to fully electrify their fleets.

Transit agencies are responsible for providing safe, affordable, and reliable transportation for riders, especially for transit-dependent low-income Californians. They provide different modes of transportation, including bus, commuter bus, passenger rail, and demand response with differing fleet sizes, composition, terrain, weather, and route length with limited budgets. Some agencies are small, operate in rural areas, and provide service with only one or two modes of transportation. Some agencies are big, serving dense urban areas with various modes of transportation and have complex service schedules and a well-equipped staff.

Transit agencies provide safe and reliable public transit services to reduce light-duty passenger vehicle miles traveled (VMT), single-occupancy trips, and congestion on roadways. Reducing VMT from passenger cars is absolutely necessary to meet our air quality and climate goals. A robust public transit system is the key to accomplishing our transportation and land use goals. Coordinated land use and transportation planning is

the cornerstone to reducing VMT, and ultimately results in healthier and more equitable neighborhoods. A vigorous transit system and affordable transit-oriented housing provides the key to improving accessibility to jobs, health care, and community services.

Zero-emission technologies are in their early commercialization stage for standard buses and pre-commercialization stage for other buses (e.g. cutaway buses, motor coaches, etc.). They are clearly demonstrating technical and economic viability, but significant effort is still needed to bring them to full utilization across all of California's diverse transit fleets. Additionally, experiences from using zero-emission technology in transit buses will benefit the market for the same technologies to be used in other heavy-duty applications. The proposed Innovative Clean Transit (ICT) regulation was developed to ensure transit service integrity and program feasibility through this transformation. The proposed regulation aims to evolve the California transit bus fleets to zero-emission technologies by 2040. Partnerships among the California Air Resources Board (Board or CARB), transit agencies, utilities, local air quality districts, and planning agencies are critical to overcoming barriers along the way.

Background and Program Overview

Under the current Transit Fleet Rule adopted nearly 20 years ago, public transit agencies operating urban bus fleets were required to select either the diesel bus path or the alternative-fuel bus path. The diesel bus path required retrofitting existing buses with diesel particulate filters, while transit agencies utilizing the alternative-fuel path had to ensure that eighty-five percent of urban bus purchases were alternative fueled buses. To date, more than half of transit buses in California operate on alternative fuels.

In the 2006 amendment to the Transit Fleet Rule, there was a 15 percent ZEB purchase requirement for larger transit agencies with more than 200 urban buses to purchase ZEBs starting in 2011. The ten transit agencies subject to the ZEB purchase requirements accounted for about 60 percent of the statewide urban bus fleet. To date, except for the ZEB purchase requirement, all other regulatory provisions have been met and are being implemented.

As part of the ZEB purchase requirement, the 2006 amendments included an advanced demonstration of ZEBs for transit agencies on the diesel path and a CARB evaluation of the status of technology. Five transit agencies in the San Francisco Bay Area formed the Zero-Emission Bay Area (ZEBA) program. The original ZEBA program included twelve FCEBs deployed in 2010 and an additional FCEB was added to the fleet and put into service in late in 2015. At the time, FCEBs were the only available zero-emission technology to meet the demands of transit service. To date, the ZEBA program has

demonstrated impressive milestone accomplishment and the feasibility of incorporating ZEBs into transit fleet operation.

In 2009, CARB staff presented evaluations of ZEB technology to the Board and concluded that ZEB technologies were not commercially ready at that time. The Board, through Resolution 09-49, found that technologies had not sufficiently advanced to appropriately assess commercial readiness, that costs of ZEBs remained significantly higher than the target prices on which the existing fleet rule had been premised, and that a new focus on GHG emission reductions from transit was appropriate. The Board directed staff to prepare proposed amendments to the regulation to delay the ZEB purchase requirement, conduct further research on commercial-readiness metrics, implement the purchase requirement once commercial readiness had been achieved, and report back to the Board in 2012 on progress towards ZEB commercialization.

In 2010, CARB staff issued a regulatory advisory to temporarily withhold the implementation of the purchase requirement for ZEBs. In the advisory, CARB stated it did not intend to enforce the ZEB purchase requirement until CARB had developed and the Board had approved new purchase requirements based on the technology evaluation.

CARB staff conducted a comprehensive technology evaluation in 2015 and concluded the ZEB technologies were now in their early commercialization stage. CARB staff updated the Board in February 2016 at a public hearing about the status of ZEB technology, price, and deployment. In that update, staff discussed plans to reinstate ZEB purchases with the Board, including the public process on amending the rule with a broader goal of making a transition to an all ZEB fleet. Staff has continued to analyze and update technical and cost information, as well as evaluate various regulatory strategies. This proposed ICT regulation is a result of that process.

Summary of Proposal

The proposed ICT regulation includes the following elements to ensure a successful and orderly transition to a ZEB fleet by 2040:

(1) ZEB Rollout Plan

- Each transit agency would be required to submit a ZEB Rollout Plan approved by governing board.
- The Rollout Plan will demonstrate how a transit agency plans for ZEB purchase and infrastructure buildout, and associated financial planning and workforce training.

- The ZEB Rollout Plan would be submitted to the Board, with due dates of June 30, 2020, for a large transit agency (with 100 or more transit buses) and June 30, 2023, for a small transit agency (with fewer than 100 transit buses).

(2) ZEB purchase requirements

- A large transit agency would purchase ZEBs according to the following schedule:
  - Starting January 1, 2023, 25 percent of annual new buses purchased;
  - Starting January 1, 2026, 50 percent of annual new buses purchased; and
  - Starting January 1, 2029, 100 percent of annual new buses purchased.
- A small transit agency would purchase ZEBs according to the following schedule:
  - Starting January 1, 2026, 25 percent of annual new buses purchased; and
  - Starting January 1, 2029, 100 percent of annual new buses purchased.

(3) Waiver for early compliance

- Purchase requirements otherwise effective in calendar year 2023 would be waived if California transit agencies collectively purchase 1,000 or more ZEBs by December 31, 2020.
- Purchase requirements otherwise effective in calendar year 2024 would be waived if California transit agencies collectively purchase 1,150 or more ZEBs by December 31, 2021.

(4) Zero-Emission Mobility Option

- A transit agency may use zero-emission cars or vans or bicycles to meet a portion of its ZEB requirements.

(5) ZEB Bonus credit

- Bonus credits for early placement of ZEBs, including extra credits for early FCEBs; however,
- Bonus credits do not apply to the waiver for early compliance.

(6) Optional Joint Zero-Emission Bus Group

- Allows for transit agencies to form a Joint Zero-Emission Bus Group to pool resources and more efficient utilization of infrastructure.

(7) Use of low NOx engines

- Starting January 1, 2020 transit agencies would be required to purchase low NOx engines if available for the bus and fuel type being purchased. The requirement does not apply to buses dispatched from NOx exempt areas.

(8) Use of renewable fuels

- Starting January 1, 2020, large transit agencies would be required to use renewable fuels for diesel and compressed natural gas (CNG) buses when fuel contracts are renewed to support existing renewable fuel policies.

(9) Deferral from ZEB purchase requirements

- A transit agency may submit a request for extension or exemption from ZEB purchase requirements, under conditions outside the transit agency's control.

(10) Reporting

- Starting 2021 all transit agencies would be required to report their fleet information annually for the prior compliance year.

Potential Impacts of the Proposal

Potential Environmental Impacts

The proposed ICT regulation is designed to assist in attaining air quality standards, reducing health risks to individuals living in California, and meeting climate change goals. The emission reductions achieved by staff's proposal will contribute to the reduction of cumulative risk of mortality and morbidity from mobile source emissions in the State. The majority of these benefits will be in the State's most populated and impacted areas where transit buses are most prevalent. These areas include the South Coast, Bay Area, San Joaquin Valley, San Diego, and the Sacramento Air Basins.

The proposed ICT regulation is expected to cumulatively reduce GHG emissions relative to current conditions by 19 million metric tons of carbon dioxide equivalent (MMT CO_2e) from 2020 to 2050. For tailpipe emissions of NOx and fine particulate matter ($PM_{2.5}$), the proposed ICT regulation is estimated to result in cumulatively 7,032 tons and 39.4 tons emission reductions, respectively, for the same time period.

CARB, as the lead agency for the proposed ICT regulation, has prepared a draft environmental analysis (Draft EA), which analyzes the ICT Regulation in accordance with the requirements of its regulatory program certified by the Secretary of Natural Resources. (California Code of Regulation, title 17, sections 60006-60008; California Code of Regulation, title 14, section 15251, subdivision (d).) The Draft EA assesses the potential for significant adverse and beneficial environmental impacts associated with the proposed actions and provides a programmatic environmental analysis of the reasonably foreseeable compliance responses that could result from implementation of the proposed regulations.

The Draft EA concluded that implementing the proposed regulations could result in the following short-term and long-term beneficial and adverse impacts: beneficial impacts to energy demand, and greenhouse gases; less than significant impacts, or no impacts, to air quality, energy demand, greenhouse gases, land use planning, mineral resources, population and housing, public service, and recreation; and potentially significant

adverse impacts to aesthetics, agricultural and forest resources, air quality, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use planning, mineral resources, noise, transportation and traffic, and utilities and service systems. The potentially significant and unavoidable adverse impacts are primarily related to short-term, construction-related activities. This explains why some resource areas are identified above as having both less-than-significant impacts and potentially significant impacts.

Potential Economic Impacts

Zero-emission vehicles are more expensive upfront but provide operational savings in terms of lower fuel and maintenance costs. This applies to all types of zero-emission vehicles including transit buses. The proposed ICT regulation from 2020 through 2050 is expected to result in a total cost saving of $1.5 billion for transit agencies, compared to the current conditions. Staff estimates that during the early stage of the proposed ICT regulation implementation (2020-2030), the annual costs for transit agencies are positive and high; and will increase over time compared to the current conditions. This is primarily because the cost of ZEBs are still much higher in early years; in addition, all associated service upgrades and infrastructure installation need to be acquired in early years. Starting in 2038, the annual savings begin to outweigh the higher incremental cost of ZEBs due to savings in ZEB maintenance, fuel costs, credit values from the Low Carbon Fuel Standard (LCFS) program, and the buildout of ZEB infrastructure.

Note that total costs do not include incentive programs such as the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP), Low Carbon Transit Operation Program (LCTOP), Transit and Intercity Rail Capital Program (TIRCP), utility investments, and other funding. For fiscal year (FY) 2017-2018, the budget allocated up to $180 million for the HVIP program with minimum of $35 million set aside to fund ZEBs exclusively. An additional $125 million has been allocated to the HVIP program per SB 856 for FY 2018-2019. Since HVIP's inception in FY 2009-2010 through April 2018, the program has paid for 47 ZEBs from eight transit agencies. As of April 2018, there are additional requests for HVIP for 139 ZEBs from nine transit agencies. The TIRCP recently announced its funding for 2018 includes 12 transit agencies for 298 ZEBs and associated infrastructure. On May 31, 2018, the California Public Utility Commission (CPUC) unanimously approved transportation electrification projects proposed by three major Investor Owner Utilities (IOUs), with a total of $738 million including $236 million from Pacific Gas and Electric and $343 million from Southern California Edison on medium and heavy-duty infrastructure, required under Senate Bill

350, chapter 547, statutes of 2015.[1] This approval would reduce the infrastructure costs to transit agencies in those utility service areas. In addition, on May 25, 2018, CARB approved allocations for Volkswagen Environmental Trust Funds that included up to $65 million for zero-emission transit buses.

In the Standard Regulatory Impacts Assessment (SRIA) that is part of this ISOR, staff estimated the economic impacts of the proposed ICT regulation using two scenarios. The economic impact of the proposed ICT regulation is then evaluated against each of the baselines. This was necessary because although the Board directed staff not to implement the ZEB purchase requirement in the existing Fleet Rule for Transit Agencies and an enforcement stay was in place, that regulation is still in effect. Therefore, the "Baseline" scenario was modeled to represent a situation as if the 2010 regulatory advisory to withhold the ZEB purchase requirement had not been issued. On the other hand, the scenario modeled as the "current conditions" is the best representation of the current real-life situation where ZEB purchases are not required because of the 2010 regulatory advisory. The latter is the scenario further discussed in this staff report.

Challenges and Long-Term Benefits

Transitioning to zero-emission technologies requires significant efforts and commitment, especially in the early years. Common challenges for deploying zero-emission technologies include high upfront capital costs for both vehicle purchase and fueling/charging infrastructure construction, fueling/charging infrastructure expansion and scalability, electricity rates, vehicle operation flexibility, and workforce training.

Staff recognizes the challenges transit agencies are facing in order to transition to ZEB fleets, and the commitments that transit agencies, local government agencies, and the State need to make. Even though ZEB technologies have advanced rapidly in recent years, continued improvements in ZEB costs and performance are still needed to facilitate the full transition to zero-emission technologies. Staff plans to provide the Board with a comprehensive update on costs, performance, and reliability of ZEBs and corresponding infrastructure.

The performance review would identify the status of ZEB technology and would help the State design policies to further advance zero-emission technologies, and inform funding strategies related to zero-emission vehicles and infrastructure. The review would occur

[1] *Application of San Diego Gas & Electric Company* (U 902E) for Approval of SB 350 Transportation Electrification Proposals (Cal.P.U.C. Decision 18-05-040 May 31, 2018) No. A 17-01-020 and Related Matters A 17-01-021, 17-01-022.

at least one year prior to the initiation of any purchase requirements. This review would look at bus categories, such as cutaway buses and standard buses individually, to ensure categorical needs and characteristics are considered.

However, the transition to zero-emission technologies is essential for California to meet its long-term air quality and climate protection goals. The proposed ICT regulation reduces GHG, PM, and NOx emissions, which will result in health benefits for individuals and communities in California. The value of these health benefits are due to fewer instances of premature mortality, fewer hospital and emergency room visits, and fewer lost days of school and work. The proposed ICT regulation also reduces energy consumption dramatically due to the much more fuel efficient electric drivetrain technology, which is essential to a low-carbon, low-polluting future for the transportation sector.

The proposed ICT regulation has multiple benefits for disadvantaged and low-income communities. First, it enhances public access to the cleanest transportation through the deployment of ZEBs and enhanced zero-emission mobility. This is crucial for transit-dependent riders, especially in disadvantaged and low-income communities where zero-emission personal vehicles are not always accessible. ZEBs and zero-emission mobility vehicles traveling through these communities would also dramatically reduce adverse health impacts from vehicle tailpipe emissions, especially on sensitive receptors. Second, the zero-emission mobility enhancement would increase access to public transit, including the zero-emission transit, and therefore expand the use of ZEBs. Third, ZEB manufacturers can bring high quality jobs to California, including in disadvantaged and low-income communities, which is a unique opportunity for these communities for workforce expansion and training.

The State is committed to using incentives to help with the transition to zero-emission technologies. There are several major funding programs established to reduce the incremental costs associated with zero-emission technologies. Some of these funding programs require early or extra action prior to a regulation in order to access funding. Staff's proposal provides sufficient time and opportunities for transit agencies to access funding and to deploy ZEBs in a manner that is consistent with a transit agency's normal bus purchase schedule. In addition, the LCFS program also allows transit agencies using fuels with a lower-carbon intensity to generate LCFS credits creating an additional revenue stream for the transit agencies as well as stimulating the low carbon fuel market. With the support of the state's funding to address some of the initial incremental costs of zero-emission technologies and the expected operating and maintenance savings of a ZEB over a conventional internal combustion engine bus, a transition to a fleet of 100 percent ZEBs is achievable and beneficial.

Transit agencies have always played a role as leaders in deploying cleaner, more efficient technologies in the entire heavy-duty vehicle sector. The experience gained from ZEB deployment is already being transferred to school buses and other heavy-duty applications, such as drayage, yard trucks, and delivery trucks. More health and environmental benefits will be harvested in the future when other heavy-duty applications are able to transition to zero-emission technologies as a result of successful ZEB deployment.

I. INTRODUCTION AND BACKGROUND

In this chapter, the California Air Resource Board (Board or CARB) staff provides a brief history of the existing Fleet Rule for Transit Agencies (Transit Fleet Rule), the importance and diversity of transit agencies in California, the current status of the zero-emission bus (ZEB) technologies and market, and a summary of the public process.

The Innovative Clean Transit (ICT) regulation would replace the existing Transit Fleet Rule that was originally adopted in 2000 and subsequently amended in 2004 and 2006. The Transit Fleet Rule was designed to serve as a diesel airborne toxic control measure that requires public transit agencies to use the best available control technologies to reduce oxides of nitrogen (NOx) and particulate matter (PM). This has been fully implemented. The Transit Fleet Rule also has a ZEB purchase requirement for the largest transit fleets. As explained below, staff monitored the implementation of that original rule and determined it was not feasible at the time. However, the technology and cost of ZEBs are significantly more favorable now and staff is now proposing a more comprehensive ICT regulation in lieu of the original ZEB requirement.

The proposed ICT regulation focuses on a long-term goal of transforming the public transit sector to zero-emission, and is designed to reduce criteria pollutants, toxic air contaminants, greenhouse gas (GHG) emissions, and to reduce community and regional air pollution. It is part of California's holistic plan to address challenging mandates and needs for public health protection, and to meet federal air quality standards and climate protection goals.

A. Regulation History

Under the current Transit Fleet Rule originally adopted in 2000 and subsequently amended in 2004 and 2006, public transit agencies operating urban bus[2] fleets were required to select either the diesel bus path or the alternative-fuel bus path. The diesel bus path required retrofitting existing buses with diesel particulate filters, while agencies

[2] Under the Transit Fleet Rule, urban bus means "a passenger-carrying vehicle powered by a heavy heavy-duty diesel engine, or of a type normally powered by a heavy heavy-duty diesel engine, with a load capacity of fifteen (15) or more passengers and intended primarily for intra-city operation, i.e., within the confines of a city or greater metropolitan area".

utilizing the alternative-fuel[3,4] path had to ensure that 85 percent of urban bus purchases were alternative fueled buses. To date, more than half of statewide transit buses are on an alternative fuel path. All agencies within the jurisdiction of South Coast Air Quality Management District (SCAQMD) followed the alternative-fuel path because these agencies were required to purchase alternative fuel buses per SCAQMD Rule 1192.[5]

In the 2006 amendment to the Transit Fleet Rule[6], there was a requirement for larger transit agencies with more than 200 urban buses to purchase ZEBs starting in 2011 for transit agencies that utilized the diesel path and one year later for transit agencies that utilized the alternative fuel path. The ten transit agencies subject to the ZEB purchase requirements accounted for about sixty percent of the statewide urban bus fleet.

To date, except for the ZEB purchase requirement, all other regulatory provisions have been met and are being implemented. The ZEB purchase requirement of the Transit Fleet Rule includes the following elements:

- Applies to transit agencies with more than 200 urban buses in active service on January 1, 2007.
- 15 percent of annual new bus purchases for those agencies must be ZEB.
- The purchase requirement starts in 2011 for transit agencies that continue to operate diesel buses and 2012 for transit agencies that switch to alternative fuels.
- The ZEB purchase requirement sunsets in 2026.

The 2006 Rule Amendment includes an advanced demonstration of the ZEB requirement for transit agencies on the diesel path with more than 200 urban buses in active service prior to the start of the ZEB purchase requirement.

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[3] As defined in the Fleet Rule for Transit Agencies, “Alternative Fuel” means natural gas, propane, ethanol, methanol, gasoline (when used in hybrid electric buses only), hydrogen, electricity, fuel cells, or advanced technologies that do not rely on diesel fuel. “Alternative fuel” also means any of these fuels used in combination with each other or in combination with other non-diesel fuels.

[4] Cal. Code Regs., tit. 13, § 2023, et seq.

[5] South Coast Air Quality Management District (SCAQMD) (2000). Rule 1192. Clean On-Road Transit Buses. Adopted June 16, 2000. Available: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1192.pdf?sfvrsn=4.

[6] California Air Resources Board (CARB) (2008). Rulemaking to Consider Proposed Amendments to the Zero Emission Bus Regulation. Last Reviewed June 3, 2008. Available: https://www.arb.ca.gov/regact/zbus06/zbus06.htm.

The 2006 amendments required CARB staff to evaluate the status of technology with the help of demonstration projects and report back to Board by July 2009.

In 2009, CARB staff presented ZEB technology evaluations to the Board and concluded that the ZEB technologies were not commercially ready at that time. The Board, through Resolution 09-49,[7] found, among other things, that technologies had not sufficiently advanced to appropriately assess commercial readiness, that costs of ZEBs remained significantly higher than the target prices on which the existing fleet rule had been premised, and that a new focus on GHG emissions reductions from transit was appropriate. The Board directed staff to prepare proposed amendments to the regulation to delay the ZEB purchase requirement, conduct further research on commercial-readiness metrics, implement the purchase requirement once commercial readiness had been achieved, and report back to the Board by 2012 on progress towards ZEB commercialization.

In 2010, CARB staff issued an advisory[8] to temporarily withhold the implementation of the purchase requirement for ZEBs. In the advisory, CARB stated it did not intend to enforce the ZEB purchase requirement until after CARB had developed and the Board had approved new purchase requirements based on the technology evaluation.

CARB staff conducted a comprehensive technology evaluation in 2015[9] and concluded the ZEB technologies were in their early commercialization stage. CARB staff updated the Board in February 2016[10] at a public hearing about the status of ZEB technology, price, and deployment. In that update, staff discussed plans to reinstate ZEB purchases with the Board, including the public process on amending the rule with a broader goal of making a transition to an all ZEB fleet. The proposed ICT regulation is a result of that process.

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[7] California Air Resources Board (CARB) (2009), Board Resolution 09-49. July 23, 2009. Available: https://www.arb.ca.gov/msprog/bus/zbus/meetings/072309/res0949.pdf.

[8] California Air Resources Board (CARB) (2010). Mail-Out #MSC 10-04. January 29, 2010. Available: https://www.arb.ca.gov/msprog/bus/zbus/mailouts/msc1004.pdf.

[9] California Air Resources Board (CARB) (2015). Draft technology assessment: medium- and heavy-duty battery electric trucks and buses. October 2015. Available: https://www.arb.ca.gov/msprog/tech/techreport/bev_tech_report.pdf.

[10] California Air Resources Board (CARB) (2016). Public Meeting Agenda – February 18, 2016 – 16-2-5 Public Meeting to Hear an Update on the Status of the Advanced Clean Transit Rule. February 18, 2016. Available: https://www.arb.ca.gov/board/ma/2016/ma021816.pdf.

B. Importance and Diversity of Transit Agencies

Public transit is an important part of the State's transportation system, providing a safe, reliable, and affordable mobility option for millions of Californians, especially for transit-dependent low-income residents. Transit systems reduce congestion on roadways, dependence on cars, and emissions while improving air quality. Transit fleets operate in local communities and have a key role not only in helping transit-dependent riders, but also in helping to shape transportation landscape through enhanced connectivity and improved mobility.

As part of the 2017 Climate Change Scoping Plan Update, the State affirmed the need for vehicle miles traveled (VMT) reductions to meet our goals for climate and community livability, and laid out its non-binding guidance on priorities for supporting local agencies to reduce vehicle travel. Actions include efforts related to implementation of regional planning in accordance with the Sustainable Communities and Climate Protection Act of 2008, Senate Bill (SB) 375, (Chapter 728, Statutes of 2008), housing and land use planning, infill development, expanded investments in transit and active transportation, and pricing policies like road user, congestion, and/or parking fees.

A robust public transit system and affordable transit-oriented housing is the key to a comprehensive transportation and land use strategy to improve accessibility to jobs, health care, community services, and to provide healthier and more equitable neighborhoods. Public transit agencies are clean air partners and have played, and will continue to play, an important role in helping California meet air quality standards and GHG emissions reduction goals; namely, by deploying the cleanest technologies, providing safe and reliable public transit services to reduce light-duty passenger vehicle miles traveled and single occupancy trips, and reducing congestion on roadways.

Transit agencies are diverse. There are currently more than 200 public transit agencies in California operating more than 12,000 transit buses. They provide different modes of transportation, including bus, commuter bus, rapid transit bus, light rail, and demand response with differing fleet sizes, composition, terrain, weather, and route lengths with limited budgets. Some agencies are small, operate in rural areas, and provide service with only one or two modes of transportation. Some agencies are big, serving dense urban areas with various modes of transportation and have complex service schedules and a large number of staff.

Figure I-1: The Percentage of Buses Distributed in Different Sizes of Fleets

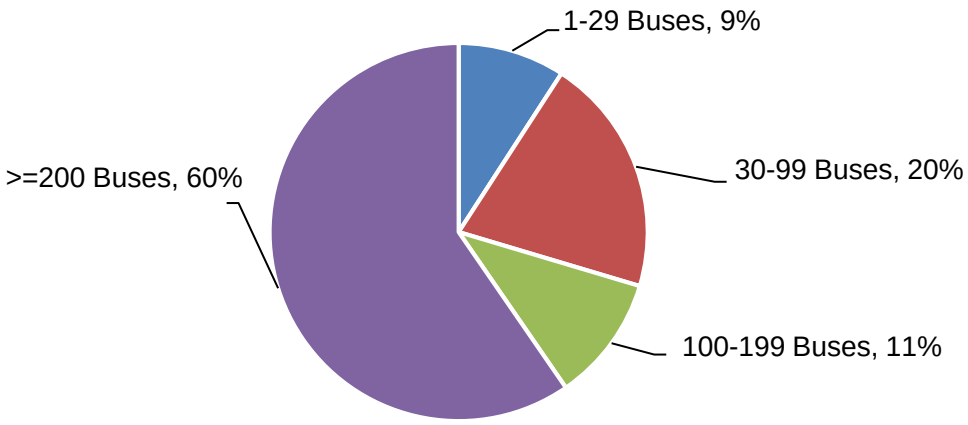

Figure I-1 shows the percentage of buses distributed by fleet size, based on the National Transit Database (NTD) 2016.[11] Understanding the diversity and dynamics of transit agencies is helpful during the development of the proposed ICT regulation which need to consider regulatory flexibility.

C. Zero-Emission Bus Technologies

ZEBs include BEBs and FCEBs. ZEBs produce zero exhaust emissions of any criteria pollutant under any and all possible operational modes and conditions. Zero-emission technologies are in their early commercialization stage for standard buses and pre-commercialization stage for other buses (e.g., cutaway buses, over-the-road buses, etc.).

Currently, there are two primary strategies for charging BEBs: depot charging and on-route charging. Depot charging is characterized by drawing electricity at a slower rate over a longer period of time. Depot charging is most commonly accomplished overnight over several hours. Currently, depot charging BEBs are commonly available with a nominal range of 150 miles per day. Longer range BEBs are also available with larger battery capacity at higher prices.

On-route charging, also referred to as opportunity charging, involves drawing large amounts of electricity from the grid in short time windows, usually 15 minutes or less.

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[11] National Transit Database (NTD) (2016). 2016 Annual Database Revenue Vehicle Inventory. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/Revenue%20Vehicle%20Inventory_0.xlsx.

On-route charging is accomplished while the bus is at a transit center or other stops on its regular route. The on-route charging systems are designed to provide unlimited range, but they are less flexible because the BEBs may need to operate on dedicated routes where these charging systems are installed.

The range and fueling time of FCEBs are comparable to conventional internal combustion engine technologies. Transit agencies, including Alameda-Contra Costa Transit District (AC Transit) and SunLine Transit Agency, use them the same way as their diesel or compressed natural gas (CNG) buses without having to dedicate a special route. As of May, 2018, four FCEBs operated by AC Transit have surpassed the 25,000-hour milestone, which is the ultimate target set by the United States Department of Energy (DOE) and the Federal Transit Administration (FTA). This demonstrated the potential for fuel cells to meet the equivalent life cycle expectancy similar to a diesel engine (see Appendix J).[12] Most of the hydrogen fuel used in the FCEBs is delivered from central production facilities or produced on-site. At this time, the bus price of FCEB remains higher than the other technologies. Hydrogen price is currently high due to low station throughput. This is expected to change as economics of scale are realized. However, FCEBs have demonstrated the feasibility of being integrated into the transit fleet operation because FCEBs can provide similar passenger capacity, range, and fueling practice as diesel or CNG buses.

D. Potential Challenges for Zero-Emission Bus Deployment

Transit agencies would need to make significant efforts, especially in the early years, to transition to ZEB fleets. Initial infrastructure investments are one of the main challenges transit agencies would need to address. Depending on the types, the location, and the size of ZEB infrastructure, the upfront costs and the time needed to deploy the infrastructure could be substantial. In addition to the upfront capital costs, there are challenges dealing with new technologies, such as operator and technician training, spare parts availability, and troubleshooting. This section discusses the main challenges.

1. Upfront Capital Costs

The total cost of ownership (TCO) of a transit bus includes both upfront capital costs and on-going operating and maintenance (O&M) costs. Capital costs include bus purchase, charging or fueling infrastructure, and maintenance bay upgrades for

[12] California Air Resources Board (CARB) (2017). AC Transit's Fuel Cell Program Breaks 25,000 Hour Operating Record. July 12, 2017. Available: https://ww2.arb.ca.gov/news/ac-transits-fuel-cell-program-breaks-25000-hour-operating-record.

servicing ZEBs. On-going O&M costs include bus and infrastructure operational and maintenance costs. As with any new technology, there could also be additional costs associated with ZEB deployment such as professional services for site assessment and rollout planning, additional procurement process, as well as operator and technician trainings.

ZEBs have higher upfront costs than CNG or diesel buses, but their operational and maintenance costs could provide significant savings over the bus lifetime. Today FCEBs have a high upfront cost but have fueling times and range that is similar to conventional internal combustion engine buses. CARB staff, transit agencies, and other stakeholders have worked collaboratively to develop cost models to characterize the costs during the deployment of ZEBs. The preliminary analysis by CARB staff shows that the TCO of a depot-charging BEB without extended range is comparable to a conventional bus within some utility areas. This conclusion is consistent with an independent study recently published by the University of California Davis[13], which broadly determined that (1) lifecycle costs of BEBs are currently comparable to conventional internal combustion engine buses if incentives are included; and (2) future lifecycle costs are expected to be beneficial with incentives.

Although the TCO of a depot charging BEB is comparable to conventional internal combustion engine buses, it is understandable that the TCO is not always the main or only criterion for transit agencies when making a purchase decision.[14] ZEB purchases as well as installation and upgrade of infrastructure serving these buses result in higher upfront capital costs for transit agencies. This could be an important factor that slows down ZEB deployment. CARB staff estimated that the incremental cost for a 40-foot depot-charging BEB (with a battery size of 324 kilowatt hour (kWh)) in 2016 was around $335,000 higher than a diesel bus and was around $285,000 higher than that of a CNG bus, based on direct communications with bus manufacturers and analysis of bus purchase contracts.[15] Initial infrastructure outlay are also substantial upfront costs. There is a limited amount of infrastructure cost information available due to a small amount of deployed ZEBs. The Antelope Valley Transit Agency (AVTA) is the first

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[13] University of California Davis (UCD) (2017). Exploring the Costs of Electrification for California's Transit Agencies. October 2017. Available: https://itspubs.ucdavis.edu/wp-content/themes/ucdavis/pubs/download_pdf.php?id=2774.

[14] Bloomberg New Energy Finance (BNEF) (2018). Electric Buses in Cities: Driving Towards Cleaner Air and Lower CO_2. March 29, 2018. Available: https://c40-production-images.s3.amazonaws.com/other_uploads/images/1726_BNEF_C40_Electric_buses_in_cities_FINAL_APPROVED_%282%29.original.pdf?1523363881.

[15] California Air Resources Board (CARB) (2017). Bus Price Analysis Discussion Draft. February 10, 2017. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626buspricesanalysis.pdf.

transit agency in the United States that is completing its conversion to an all-ZEB fleet; therefore, its infrastructure data are used in the TCO analysis. The data shows electrical service upgrade and installation cost is estimated to be around $55,000 per depot charger for a large BEB deployment. This cost included trenching, cables and transformers. The cost for the charger is an additional cost.[16] AVTA's planned capacity is for an eighty-five ZEB fleet which is smaller than some large fleets' planned capacity for each facility. Utility service upgrades are expected to be highly variable and could higher or lower at different sites.

Incremental costs for ZEBs have been declining and are expected to continue to decline as the market grows and matures. It is widely acknowledged that large orders will result in a reduced bus price. For example, a recent large purchase of ZEBs by the Los Angeles County Metropolitan Transportation Authority (LA Metro) had an incremental cost that is less than half of the value used in CARB staff analysis.[17,18] The large purchase volume and LA Metro's potential purchasing power may have resulted in lower prices than other transit agencies could get. Larger bus orders and economies of scale are expected to lower the incremental ZEB capital costs; however, cost reductions associated with economies of scale are challenging to estimate and were not used in the statewide cost analysis.

Funding programs can help address the upfront incremental costs of ZEBs. As discussed in Section C of Chapter III, federal, state and local funding programs, including CARB funded Hybrid and Zero-Emission Truck and Bus Voucher (HVIP), play an important role in early stages of the ICT regulation implementation to provide a smooth transition and to mitigate upfront costs for transit agencies. A minimum of $35 million of HVIP funds has already been allocated for public transit buses in FY 2017-2018.

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[16] California Air Resources Board (CARB) (2017). Innovative Clean Transit - Cost Data and Sources. June 26, 2016. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626costdatasources.xlsx.

[17] Los Angeles County Metropolitan Transportation Authority (LA Metro) (2017). Attachment C – Funding Expenditure Plan, 295 Bus Contract, LA Metro Board Report. System Safety, Security and Operations Committee. June 15, 2017. Available: https://metro.legistar.com/View.ashx?M=F&ID=5245046&GUID=773DE846-1FAD-4972-B189-A78C183A546C.

[18] Los Angeles County Metropolitan Transportation Authority (LA Metro) (2017). Attachment C – Funding Expenditure Plan, Sixty 40' Zero Emission (ZE) Transit Buses (Part C), LA Metro Board Report. System Safety, Security and Operations Committee. July 27, 2017. Available: https://metro.legistar.com/View.ashx?M=F&ID=5316630&GUID=A1544720-E01A-4135-ABCF-689A6E61E9BA.

Lease payment of ZEBs or batteries for ZEBs could also be a method for transit agencies to change their procurement approach and to focus more on lower upfront capital costs though it will increase the total cost of ownership due to the interest. Some bus manufacturers offer multiple financing programs to help transit agencies mitigate high upfront costs and reduce risks in operation.

2. Charging and Fueling Infrastructure and Electricity Rate

In many cases, electrical infrastructure (e.g. trenches, transformers, switchboards, and conduit) will need to be upgraded or installed in order to accept the high-power service necessary to support multiple chargers. These costs are dependent on a number of site-specific variables. Large bus deployments may require more costly investments. As mentioned previously, AVTA's initial cost estimates suggest it will cost four to five million dollars for the addition of eighty-five depot chargers.[19] Space required for installing the chargers at a depot or bus stop can also be an issue. Besides construction, upgrade and installation of infrastructure involves coordination with other parties, such as an electric utility and permitting agency, and will take time to be put in place. Additionally, to "future-proof" electrical infrastructure investments, transit agencies may consider sizing the upgrades to support higher charging power levels (e.g. 350 kilowatt (kW) or more per charger) envisioned by emerging standards.

The amount of space or footprint and capital cost of a hydrogen station is usually determined by the method to produce hydrogen and throughput or capacity of the station.[20] Similar to charging infrastructure, construction and operation of hydrogen stations also involves different agencies in issuing permits, such as land use and air permits.[21] Hydrogen stations at transit yards are often built to be scalable. The equipment is similar to a CNG station, and therefore a station can increase its capacity from 40 to 400 buses by upgrading the compression and storage equipment, and adding dispensers without entailing ten times the investment.

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[19] Antelope Valley Transit Agency (AVTA) (2016). Email communication with Len Engel, Executive Director of AVTA, on August 26, 2016.

[20] The Linde Group (2016). Enabling Fuel Cell Bus Deployment: Technology from Linde. February 4, 2018. Available: https://www.arb.ca.gov/msprog/bus/meet/tspresent/s4_natesan.pdf.

[21] Arnold & Porter (2015). Hydrogen Fuel Stations in California: A Practical Guide to Permitting and CEQA Review. April 2015. Available: https://files.arnoldporter.com/ebook-hydrogen%20fuel%20stations%20in%20california.pdf.

Overall, considering the complexities of charging and fueling infrastructure for BEBs and FCEBs, early planning of ZEB procurement as well as infrastructure can at some level ease this kind of challenge.

The electricity rate varies with factors such as electric utility, number of buses deployed in a depot, and charging strategy. Electric utilities typically charge commercial customers in three ways: usage-independent fee as a fixed fee for each electricity meter ($/month), usage charges in terms of cost per kilowatt-hours ($/kWh), and demand charges in terms of cost per kilowatts ($/kW). Whether a bus fleet is charged during daytime or nighttime to avoid on-peak usage charges, and whether the buses are charged at the same time or sequentially to reduce demand charge can affect the electricity rate significantly. An individual transit agency may experience higher average electricity cost when charging a small number of buses at a depot and will have lower average electricity costs as more BEBs are charged at the site.

There are options for transit agencies to reduce or manage electricity costs, such as a fleet management system that uses software onboard of buses to do strategic charging. Other options include on-site electricity generation or off-grid charging as well as stationary energy storage that charges buses when electricity is in low demand. Unused electricity generated on-site can also be used to mitigate peak demand and commodity charges.

The California Public Utilities Commission (CPUC) is collaborating with CARB and California Energy Commission (CEC) to implement requirements set forth by Senate Bill 350 (SB 350) to support widespread transportation electrification, as discussed in Section C of Chapter III. The three major investor owned utilities (IOUs) have proposed or been approved to invest in medium- and heavy-duty infrastructure projects to support transportation electrification to offset a substantial part of the costs of making electrical service upgrades and installing charging infrastructure over a 5-year period.[22]

3. Deployment Flexibility and Scalability

To start transitioning to ZEBs, transit agencies would need to consider which zero-emission technology or technologies would be most suitable to meet their needs. It is essential to work with technology and fuel providers as early as possible regardless

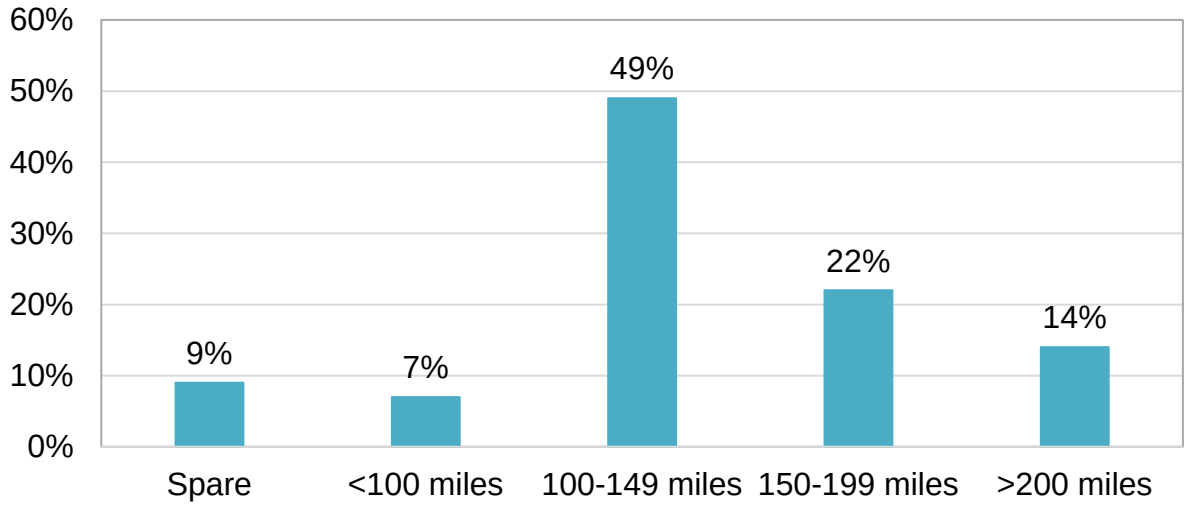
[22] *Application of San Diego Gas & Electric Company (U 902E) for Approval of SB 350 Transportation Electrification Proposals* (Cal.P.U.C. Decision 18-05-040 May 31, 2018) No. A 17-01-020 and Related Matters A 17-01-021, 17-01-022.*See also* California Public Utilities Commission (CPUC) (2017). SB 350 Transportation Electrification Applications Overview: Background & Proceeding Process. February 8, 2017. Available: http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442452499.

which technology to deploy. The planning work may involve route simulation. Recognition of vehicle specifications is also necessary to identify suitable route/blocks.

BEBs can be less flexible than FCEBs and internal combustion engine buses due to their range limitation. Initially, this may make it difficult to incorporate them into bus blocks/routes with long daily ranges or long running hours. On-route charging can accommodate fast charging on the road in about 15 minutes but is more expensive. In addition, the operation of on-route charging BEBs is limited by the location of chargers. It also could be challenging for transit agencies to plan for layover time for charging and select routes for on-route charging BEBs.

Depot charging BEBs are currently commonly available with a nominal range of 150 miles per day. This capacity, with a discounted range due to the use of heat, ventilation, and air conditioning (HVAC) and other electronic devices on board, would only meet transit agencies' needs in the early years to apply to their short-range bus service. Some bus manufacturers have developed models with ranges over 200 or 300 miles per charge to meet transit agencies' needs. The survey data from transit fleets in Figure I-2 shows that for 40-foot buses, about 50 percent of buses operate less than 150 miles per day, and about 85 percent of buses operate less than 200 miles per day.[23]

Figure I-2: Survey Statistics of Daily Standard Bus Mileage Distribution



[23] California Air Resources Board (CARB) (2016) Transit Agency Survey Preliminary Results, ACT Workgroup Meeting, August 29, 2016. Available: https://www.arb.ca.gov/msprog/bus/transit_survey_summary.pdf.

Charging standardization is essential for the large-scale deployment of BEBs. The Society of Automotive Engineering (SAE) is developing heavy-duty vehicle charging standards. Applicable standards commonly implemented on buses and other medium- and heavy-duty vehicles include the SAE J1772 Combined Charging Standard. SAE standard J3068 for plug-in (conductive) charging of heavy-duty vehicles has recently been finalized[24,25], while J3105 for overhead (conductive) charging may be available soon and J2954 for wireless (inductive) charging is planned to be available in a year or two. As standards for the industry are developed, deployment costs will decrease.

FCEBs do not have range limitation concerns. Scaling up hydrogen fueling infrastructure is challenging but feasible. Further progress is needed on total cost of ownership, landscape footprint to lower hydrogen fueling costs.[26]

Recognizing the emerging nature of the technology, the proposed ICT regulation includes a gradual ramping-up ZEB phase-in curve, starting with lower ZEB purchase requirements at the beginning and gradually increasing. Transit agencies could apply operational experience with small deployments in early years to scale up.This phase-in schedule allows time for transit agencies to develop a smooth transition path.

4. Training Needs

ZEBs will require workforce training development. However, there are limited resources and curriculum available on ZEB technology at present. Different technologies also require different sets of training. The training usually requires 30 minutes behind the wheel and 1 to 2 hours of classroom training.[27] Additional hours for safety and system familiarization is also required for bus operators.

Training materials for technicians and operators may vary by zero-emission technology, and they generally include powertrain related (e.g., fuel cell power plant, lithium-ion battery, electrical drive system, etc.) safety and familiarization and hands-on technical

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[24] Society of Automotive Engineering (SAE) International (2018). Electric Vehicle Power Transfer System Using a Three-Phase Capable Coupler J3068_201804.

[25] Truckinginfo (2018). SAE Publishes Charging Recommendation for Medium- and Heavy-Duty Electric Vehicles. April 27, 2018. Available: http://www.truckinginfo.com/channel/fuel-smarts/news/story/2018/04/sae-approves-new-three-phase-charger-for-electric-vehicles.aspx.

[26] Center for Transportation and the Environment (CTE) (2016). 2016 International Zero Emission Bus Conference (IZEBC). December 1, 2016. Available: http://www.cte.tv/wp-content/uploads/2016/12/ZEBC-Summary-Report.pdf.

[27] Alameda-Contra Costa Transit District. Email communication with Lee Donnell, Maintenance Superintendent, on June 27, 2017.

experience. For example, AC Transit provides fuel cell bus hands-on training where the technicians work hand in hand with a training instructor, and the class is about 100 hours per technician. [28]

Some pioneer ZEB-adopting transit agencies have played an important role as ZEB technology educators and have developed curriculums to share and provide workforce training programs in zero-emission transportation technologies that supports commercial operation of ZEBs. For example, the Center of Excellence in Zero-Emission Technology (CoEZET) at the SunLine Transit Agency is a collaboration between public and private organizations, including transit agencies, colleges, private industry, and government agencies.[29] The center provides both advanced technician training, which provides side-by-side training with experienced technicians on ZEBs and supporting infrastructure, as well as management training which helps managers to understand the regulatory environment, ZEB procurement, route planning, and financial modeling.

Another example of workforce training associated with ZEB deployment comes from AC Transit and its project partners. They established a comprehensive in-house training program to ensure that the appropriate staff gained familiarity with hydrogen as a fuel technology and received detailed maintenance and operations information for FCEBs. They also developed training courses and videos to educate the public, transit staff, and first responders.[30] AC Transit's training programs will now be expanded and made available to other transit agencies. As of May 2018 they have accomplished more than 13,000 total hours of training, of which more than 11,000 hours were spent training and getting hands-on technical experience of ZEB technology.[31]

E. Performance Review of Zero-Emission Bus Technologies

Staff recognizes the challenges transit agencies are facing in order to transition to ZEB fleets, and the commitments that transit agencies, local government agencies, and the State need to make. Even though ZEB technologies have advanced rapidly in recent years, continued improvements in ZEB costs and performance are still needed to

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[28] Zero-Emission Bay Area (ZEBA) (2018). ZEBA Summary Report in May 2018.

[29] California Fuel Cell Partnership (CaFCP) (2016). SunLine Center of Excellence in Zero Emission Technology: Status Update. August 30, 2016. Available: https://cafcp.org/sites/default/files/7_SunLine-CoE-in-Zero-Emission-Technology_CaFCP-Bus-Team-meeting-Aug2016.pdf.

[30] U.S. Department of Transportation Federal Transit Administration (FTA) (2010). National Fuel Cell Bus Program: Accelerated Testing Evaluation Report #2. June, 2010. Available: http://www.actransit.org/wp-content/uploads/NREL_rept_JUN2010.pdf.

[31] Zero-Emission Bay Area (ZEBA) (2018). ZEBA Summary Report in May 2018.

facilitate the full transition to zero-emission technologies. Staff plans to provide the Board with a comprehensive update on costs, performance, and reliability of ZEBs and corresponding infrastructure.

The performance review would identify the status of ZEB technology and would help the State design policies to further advance zero-emission technologies, and inform funding strategies related to zero-emission vehicles and infrastructure. The review would occur at least one year prior to the initiation of any purchase requirements. This review would look at bus categories, such as cutaway buses and standard buses individually, to ensure categorical needs and characteristics are considered. Staff envisions the performance review will comprise the following components:

- **Costs.** Costs include infrastructure and vehicle capital, operating and maintenance costs. Infrastructure capital costs include charging/refueling equipment, installation, and utility upgrade costs.
- **Battery performance.** Batteries used in the ZEBs will degrade over time. The assessment will help identify how battery degradation may affect daily operating range as vehicles age, and whether transit buses would require mid-life battery replacement. The assessment can help to estimate the remaining battery capacity after the end of their useful life in buses.
- **Operating range.** The maximum operating range of a vehicle after it is fully charged or refueled. Range assessment will take into consideration various factors, such as energy storage capacity, battery degradation, HVAC, passenger loading, and grades. Understanding real world operating range is essential for a transit agency to plan for its routes and schedule using ZEB technologies.
- **Performance and reliability.** Different from small pilot or demonstration projects, a successful system-wide transition to the ZEB technologies must demonstrate the reliability and viability of the technologies. Measurements could include bus availability, road call frequency, and other performance metrics, such as fuel efficiency and factors affecting fuel efficiency, refueling or charging time and frequency, and parts availability.

F. Status of Zero-Emission Bus Market

California has the most ZEBs deployed in the United States. To date, multiple fleets, including transit agencies and universities, are already operating ZEBs in regular revenue service. For example, in 2009-2010, five transit agencies in the Bay Area formed the Zero-Emission Bay Area (ZEBA) program. The original ZEB program included twelve fuel cell electric buses (FCEBs) deployed in 2010 and an additional FCEB was added to the fleet and put into service in late in 2015. At the time, FCEBs were the only available zero-emission technology to meet the demands of transit service. More details about this program are discussed in Appendix J.

There are many building blocks toward ZEBs. For example, the San Francisco Municipal Transportation Agency (SFMTA) has operated zero-emission trolley buses since 1935 and currently have over 250 in service. SFMTA also operates diesel electric buses which can be converted to pure electric and the newest of which have the ability to generate in pure-electric mode over designated "green zone."[32,33]

As of May 2018, there were 132 ZEBs in operation by transit agencies in California and another 42 in operation at California universities. At least an additional 729 ZEBs are on order, have been awarded funding or are been planned from transit agencies (Figure I-3).[34,35] Twelve transit agencies, together with over 5,200 buses representing about 40 percent of all buses in California, have already committed to fully electrify their fleets, as shown in Table I-1.

California is home to ZEB manufacturing which creates high quality employment opportunities. Five manufacturers, including BYD, El Dorado National-California, GILLIG, GreenPower, and Proterra, have ZEB manufacturing plants producing either BEBs or FCEBs or both in California. GreenPower's BEB manufacturing plant in Porterville is currently under construction. In addition, both BYD and Proterra also have battery production plants in California. BYD, Proterra, and GreenPower manufacture only zero-emission vehicles; the other manufacturers also produce buses with internal combustion engines. Table I-2 shows the locations of these bus manufacturers.

[32] San Francisco Municipal Transportation Agency (SFMTA) (2016). How Electric Trolley Buses Became Muni's Backbone. September 15, 2016. Available: https://www.sfmta.com/blog/how-electric-trolley-buses-became-munis-backbone.

[33] San Francisco Municipal Transportation Agency (SFMTA) (2018). San Francisco Commits to All-Electric Bus Fleet by 2035. May 15, 2018. Available: https://www.sfmta.com/sites/default/files/reports-and-documents/2018/05/press_release-allelectricfleet4.pdf.

[34] California Air Resources Board (CARB) (2018). Battery and Fuel Cell Electric Buses in California. May, 2018. Available: https://arb.ca.gov/msprog/ict/faqs/zbusmap.pdf.

[35] 132 ZEBs are in operation and 655 ZEBs are on order, awarded or planned as of May 2018.

Figure I-3: Battery and Fuel Cell Electric Buses in California (As of May 2018)

Table I-1: Transit Agencies Committed to 100 percent Zero-Emission Bus Target

Agency Name	Total Buses[a]	All ZEB Target (as of May 2018)
Antelope Valley Transit Authority	77	2018
Anaheim Resort Transportation	82	2019/2020
Porterville Transit	20	2025
San Joaquin Regional Transit District	111	2025
Foothill Transit	373	2030
Los Angeles County Metropolitan Transportation Authority	2,452	2030
Los Angeles Department of Transportation	357	2030
Santa Monica Big Blue Bus	200	2030
San Mateo County Transit District	369	2033
Santa Clara Valley Transportation Authority	485	2033
San Francisco Municipal Transportation Agency	620[b]	2035
Santa Cruz Metro Transit District	98	2040[c]
Total	**5,244**	

[a] Data Source: NTD 2016, including only vehicles reported in NTD 2016 as vehicle types bus, articulated bus, over-the-road bus, and double decker, and mode types CB,MB,DR, and RB.

[b] 327 electric trolley buses are not included in 2016 NTD total bus number.

[c] Total bus numbers exclude paratransit vehicles. 2040 target is not a directive from Board. Achieving the target is subject to range, technology improvement, and funding.

Table I-2: Zero-Emission Standard Bus Manufacturers in California

Manufacturer	CA Facilities	Propulsion Technology	Total Bus Production Capacity per Year**
BYD	Lancaster*	BEB, BE trucks, FCEB[36] and Battery	1500
El Dorado National-California	Riverside	FCEB and IC	
GILLIG	Livermore	BEB and IC	
GreenPower	Porterville	BEB	150
Proterra	Burlingame	Battery	
Proterra	Industry	BEB	500

* The bus is manufactured in Lancaster, California and fuel cell made in South Windsor, Connecticut.

** Annual production capacity for all types of buses, including conventional internal combustion engine buses. Areas without public information are left blank.

[36] BYD (2018). Press Release: BYD, US Hybrid Develop First-Ever Hydrogen/Electric Bus. May 2, 2018. Available: http://en.byd.com/usa/news-posts/press-release-byd-us-hybrid-develop-first-ever-hydrogen-electric-bus/.

There are also a number of manufacturers located outside California that produce ZEBs. Nova Bus currently offers a battery electric transit bus manufactured in Canada. New Flyer is the largest transit bus manufacturer in North America and has production facilities in numerous states. New Flyer offers battery and fuel cell electric bus options on an existing platform. These manufacturers are offering ZEBs in different bus sizes and configurations, including standard buses, over-the-road buses, articulated buses, double-decker buses and other configurations.

There are other bus manufacturers and providers that primarily produce small ZEBs that are typically shorter than 26-feet, such as eBus, Phoenix Motorcars, Zenith, Motiv, and Lightning Systems. Motiv and Lightning Systems have partnered with Ford in its electric qualified vehicle modifier program, or eQVM, to produce electric trucks, buses and vans. Although some of these buses have been deployed, they have not been demonstrated in transit service at this time. Furthermore, none of the small ZEBs have gone through the Altoona testing[37,38] or can be purchased by transit agencies with federal formula funding on a regular basis.

G. Summary of Public Process

To ensure an open and transparent rulemaking, CARB staff has engaged in an extensive public process. Staff created a technical workgroup that encompasses interested stakeholders including transit agencies, environmental groups, utilities, technology providers, fuel providers, and carbon markets activists. In addition, CARB staff has created a Transit Subcommittee with two subgroups on cost and regulatory concepts to discuss transit specific issues.

Besides meetings in group settings, CARB staff has also had dozens of meetings with numerous transit agencies in groups or individually. At the same time, staff has had frequent discussions with ZEB technology providers and environmental nongovernmental organizations.

Since 2015, CARB staff has had a Board hearing for an informational update and held three statewide workshops, five workgroup meetings, four Subcommittee meetings, various subgroup meetings, one Low Carbon Fuel Standard overview meeting, three transportation electrification meetings, and one technology symposium to provide information to the public and solicit feedback. Staff has also visited and toured 19

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[37] Federal Transit Administration (FTA) (2017). Bus Testing. Updated February 22, 2017. Available: https://www.transit.dot.gov/research-innovation/bus-testing.

[38] Federal Transit Administration (FTA) (2018). The Altoona Bus Research and Testing Center. Available: http://altoonabustest.psu.edu/.

transit agencies, covering air basins of Mojave Desert, Sacramento Valley, Salton Sea, San Diego, San Francisco Bay Area, San Joaquin Valley, and South Coast. CARB staff posted information regarding these workshops, meetings, symposium, and any associated materials on the ICT website[39] and distributed notice of these meetings through a public list serve that includes over 5,300 recipients. At the meetings which are available by webcast and teleconference, CARB solicited stakeholder feedback on the regulation and regulatory process.

[39] California Air Resources Board (CARB) (2018). Innovative Clean Transit Meetings and Workshops. Last Reviewed June 19, 2018. Available: https://arb.ca.gov/msprog/ict/meeting.htm.

II. THE PROBLEMS THAT THE PROPOSAL IS INTENDED TO ADDRESS

California needs to promote transformative innovation in the transportation sector, and support demand for increasingly lower-carbon intensity fuels to achieve our mid- and long-term GHG targets to address the public health and environmental impacts of climate change. California also needs to continue to reduce NOx and other criteria pollutants to meet the State Implementation Plan (SIP) commitments and protect public health and our environment. In this chapter, CARB staff provide a description of the purpose for the rulemaking and the problems the proposed amended regulations are intended to address. A description, purpose and rationale for each of the proposed updates and revisions are provided in Chapter X.

To achieve the overall air quality and climate protection goals, California needs a holistic approach comprising a suite of comprehensive and complementary measures, such as cleaner grid and combining emerging technologies The transportation sector is responsible for about 40 percent GHG emissions[40], 80 percent of NOx emissions, and 90 percent of diesel PM in California.[41] Broadly implementing zero-emission technologies is a necessary component to effectively address these multiple intertwined and complicated air quality and climate protection issues. The proposed ICT regulation is a leading part of this suite for heavy-duty vehicles to help achieve the emission reductions and health benefits. The following subsections will explain the problems this proposal will address and the significant role that ZEBs play in achieving California's air quality and climate protection goals.

A. Need for Emission Reductions

To date, California has made significant progress towards meeting federal air quality attainment standards and is currently on track to meet the goals of Assembly Bill 32 (AB 32) (Nuñez, Chapter 488, Statutes of 2006), the California Global Warming Solutions Act of 2006. AB 32 requires California to reduce GHG emissions to 1990 levels by 2020 and maintains that level afterwards. But more needs to be done.

The California legislature further adopted Senate Bill 32 (SB 32) (Pavley, Chapter 249, Statutes of 2016), amending the California Global Warming Solutions Act, to require the

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[40] California Air Resources Board (CARB) (2018). California Greenhouse Gas Emissions. Trends of Emissions and Other Indicators. Released July 11, 2018. Available: https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.

[41] California Air Resources Board (CARB) (2016). Mobile Source Strategy. May, 2016. Available: https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf.

statewide GHG emissions target to be at least 40 percent below 1990 levels by 2030 and maintains that level afterwards.

In December 2017, the Board adopted the Scoping Plan Update, known as California's 2017 Climate Change Scoping Plan (2017 Scoping Plan),[42] building on the state's successes to date, proposing to strengthen major programs that have been a hallmark of success, while further integrating efforts to reduce both GHG and air pollution. California's climate efforts will:

- Lower GHG emissions on a trajectory to avoid the worst impacts of climate change;
- Support a clean energy economy which provides more opportunities for all Californians;
- Provide a more equitable future with good employment opportunities and less pollution for all communities;
- Improve the health of all Californians by reducing air and water pollution and making it easier to bike and walk; and
- Make California an even better place to live, work, and play by improving our natural and working lands.

The federal Clean Air Act requires areas that exceed the health-based national ambient air quality standards to develop the SIPs that demonstrate how they will attain the standards by specified dates. In March 2017, the Board adopted the State Strategy for the State Implementation Plan (State SIP Strategy) and directed staff to provide an annual status report on progress in implementing the strategy.

The proposed ICT regulation, and deployment of ZEBs, is identified in the State SIP Strategy [43] and the in the 2017 Scoping Plan as a necessary component for California to achieve established near- and long- term air quality and climate mitigation targets. Zero-emission technologies are needed to achieve the maximum GHG and NOx emissions reductions and meet our long-term air quality and climate goals.

B. Need to Reduce Energy Consumption

ZEBs consume less fuel energy than conventional internal combustion engine buses in the same distance travelled. They are 2 to 5 times as efficient as buses with internal

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[42] California Air Resources Board (CARB) (2017). California's 2017 Climate Change Scoping Plan. November, 2017. Available: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

[43] California Air Resources Board (CARB) (2017). Revised Proposed 2016 State Strategy for the State Implementation Plan. March 7, 2017. Available: https://www.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf.

combustion engine technologies and significantly reduce petroleum and other fossil fuel use.

BEBs, such as those operated at Foothill Transit, demonstrated an average efficiency of about 2.15 kWh per mile[44], which translates to about 17.5 miles per diesel gallon equivalent (DGE), while CNG buses usually have an average fuel efficiency of 4-5 miles per DGE. The high fuel efficiency of ZEBs, coupled with low carbon intensity fuels like electricity and hydrogen, makes these technologies very attractive in reducing GHG emissions.

C. Need to Lead Zero-Emission Technology in the Heavy-Duty Sector

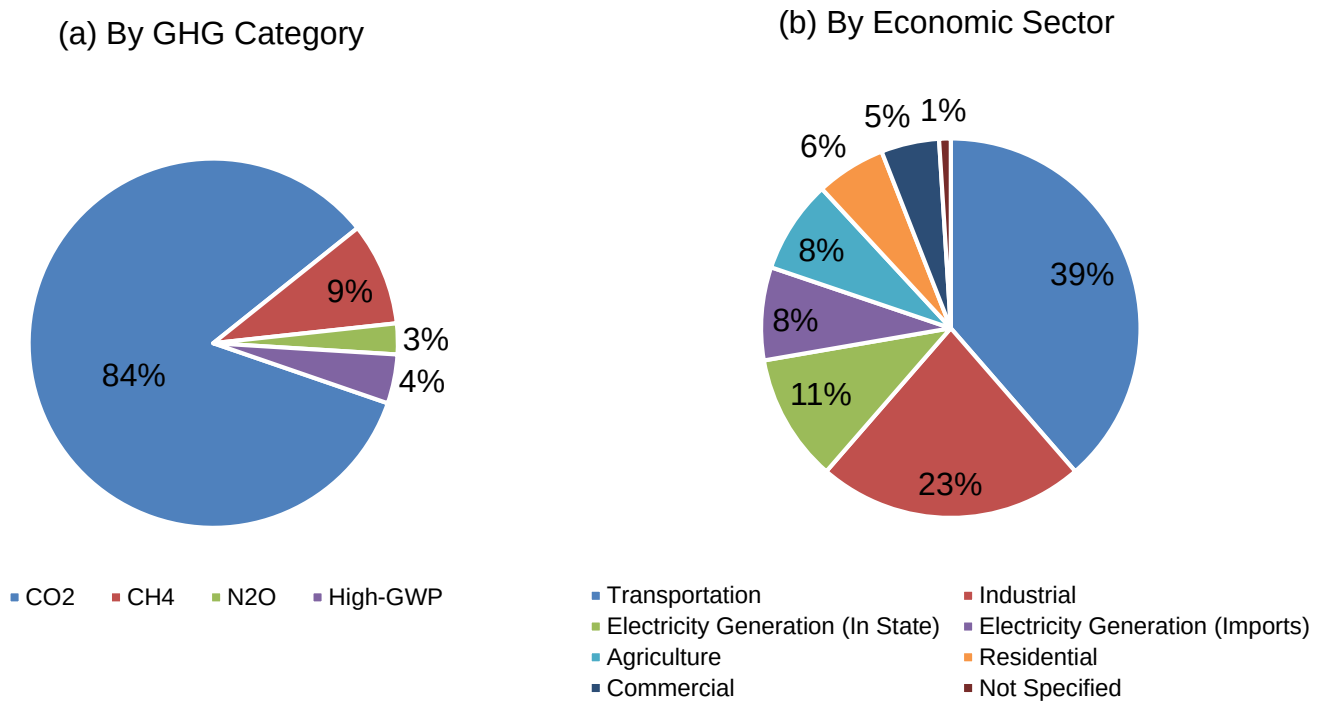
1. GHG Emission from the Transportation Sector

Carbon dioxide (CO_2) is the primary GHG emitted in California, accounting for 84 percent of total GHG emissions in 2015[45], as shown in Figure II-1. The GHG emissions inventory further shows that the transportation sector, primarily comprised of on-road travel, is the single largest source of CO_2 in California. Californians can reduce CO_2 emissions by driving less and switching to a more fuel-efficient vehicle technology. The proposed ICT regulation is poised to set an example in both of these ways, and the experience gained from deployment of ZEBs is expected to transfer to other heavy-duty vehicles.

[44] National Renewable Energy Laboratory (NREL) (2017). Foothill Transit Battery Electric Bus Demonstration Results: Second Report. June, 2017. Available: https://www.nrel.gov/docs/fy17osti/67698.pdf.

[45] California Air Resources Board (CARB) (2018). California Greenhouse Gas Inventory for 2000-2016 — by Gas. Last Updated June 22, 2018. Available: https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_bygas.pdf.

Figure II-1: 2015 California Total GHG Emissions by GHG Category and by Economic Sector



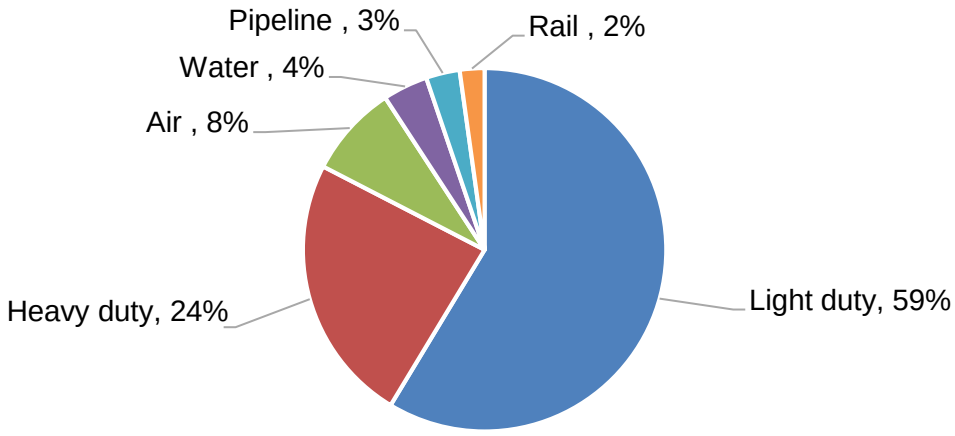
2. Importance of the Heavy-Duty Sector

While heavy-duty vehicles only account for two percent of California vehicle population[46], they account for 24 percent of transportation energy use[47], shown in Figure II-2. Zero-emission technologies for heavy-duty vehicles are very important to reduce CO_2 emissions as well as to reduce energy consumption from vehicles.

[46] California Air Resources Board (CARB). EMFAC2017 Web Database (v1.0.2). EMFAC2017 (v1.0.2) Emissions Inventory, Region Type: Statewide, Region: California, Calendar Year: 2016, Season: Annual, Vehicle Classification: EMFAC2011 Categories. Available: https://www.arb.ca.gov/emfac/2017/.

[47] Oak Ridge National Laboratory (ORNL) (2018). Transportation Energy Data Book Edition 36.1. Table 2.8. Transportation Energy Use by Mode, 2014-2015. Released April 30, 2018. Available: https://cta.ornl.gov/data/tedbfiles/Spreadsheets/Table2_08.xls.

Figure II-2: Transportation Energy Share



3. Zero-Emission Bus as the Beachhead of Zero-Emission Technology

The proposed ICT regulation is the first step in a broader statewide strategy to begin the transition to zero-emission technologies for heavy-duty vehicles, because transit buses are an optimal starting point for this transition. Transit agencies have always and will continue to play an important role in benefiting local communities, improving the State's air quality, and mitigating climate changes, through deploying the cleanest technologies. Transit agencies have historically been pioneers in adopting advanced technologies and several of them have been successfully operating ZEBs for one or two decades as part of their normal daily operations in California. As the ZEB technologies become more mature, more transit agencies have set goals for complete ZEB turnover of their fleet in the future.

Transit buses operated by transit agencies are ideal candidates for zero-emission technologies. Transit buses are usually operated in urban centers and incorporate low speed and frequent stop-and-go driving cycles. Consequently, transit buses are ideal applications for electric drivetrains with regenerative braking and could also utilize overhead or inductive on-route charging.

Most importantly, experience from using zero-emission technology in buses and demonstrating its viability will benefit the market for the same technologies to be used in other heavy-duty vehicle applications. This is why ZEBs and their electric drivetrains have been identified as the beachheads, or technology footholds, of medium- and

heavy-duty zero-emission vehicle (ZEV) technologies.[48] The knowledge and experience gained from installing supporting infrastructure, developing training programs, and gaining operating experience with ZEB technologies is enabling market expansion into other heavy-duty vehicle applications. The experiences will transfer from transit agencies to school buses, delivery trucks, and vocational vehicles, which have similar weight considerations, durability requirements, drivetrains, and components. This is especially true because transit agencies are public entities and must share information with the general public. The proposed ICT regulation and resulting ZEB deployment will complement other heavy-duty ZEV applications, such as local delivery trucks,[49] airport shuttles,[50] yard trucks, and drayage trucks.

[48] California Air Resources Board (CARB) (2017). Proposed Fiscal Year 2017-18 Funding Plan for Clean Transportation Incentives. Released November 9, 2017. Available: https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1718_funding_plan_final.pdf.

[49] California Air Resources Board (CARB) (2018). Advanced Clean Trucks. Last Reviewed May 10, 2018. Available: https://www.arb.ca.gov/msprog/actruck/actruck.htm.

[50] California Air Resources Board (CARB) (2018). Zero-Emission Airport Shuttle Bus. Last Reviewed April 11, 2018. Available: https://www.arb.ca.gov/msprog/asb/asb.htm.

III. OVERVIEW OF PROPOSED ACTIONS AND RELATED PROGRAMS

A. Summary of Proposed Actions

The proposed ICT regulation is part of a holistic approach to transform the transportation sector. The ICT regulation amends the existing Fleet Transit Rule and focuses on a long-term goal of transforming the public transit sector to zero-emission modes. The overall strategy of the proposed ICT regulation includes a combination of incentives and regulatory measures to provide a strong market signal for zero-emission technology deployment, utilization of certified low-NOx engines, the use of renewable fuels, and encouraging innovative mobility solutions. The proposed ICT regulation includes flexibility to allow transit fleets to implement zero-emission technologies in a way that is consistent with their operation, provides opportunities for transit fleets to utilize incentives, and encourages innovative mobility options.

The proposed ICT regulation applies to all public transit agencies in California that own, operate, lease, or rent affected buses, or contract out their operation with another entity. It affects all buses with gross vehicle weight rating (GVWR) greater than 14,000 lbs., but does not include trolleybuses. Key elements of the proposal include the following:

(1) Transit agencies would be required to develop individual Rollout Plans to transition to a ZEB fleet by 2040.
(2) Transit agencies would be required to acquire a minimum number of ZEBs at the time of new bus purchases, based on the required percentage of the total new bus purchases.
(3) ZEB purchase requirements for calendar years 2023 and 2024 would be waived, if transit agencies collectively are purchasing a minimum number of ZEBs.
(4) An option to implement zero-emission mobility programs in lieu of ZEB purchases as well as other flexibility options.
(5) Requirement to purchase of low-NOx engines if available for conventional internal combustion engine bus purchases.
(6) Requirement to purchase of renewable fuels when diesel or natural gas contracts are renewed.
(7) All transit agencies would be required to report their fleet information annually starting from 2021.

The following subsections provide a brief overview of the proposed rule concepts. The specific details of the purpose and rationale for each concept will be discussed in Chapter X.

1. Zero-Emission Bus Rollout Plan

To assist with ZEB purchase requirements, CARB staff is proposing to require a Zero-Emission Bus Rollout Plan (Rollout Plan) from each transit agency. The Rollout Plan would need to describe how a transit agency is planning to achieve a full transition to zero-emission technologies and would need to be approved by the transit agency board. The plan would need to include information about the type of ZEBs to be purchased and their replacement and purchase schedules, including the timing of their placement in Disadvantaged Communities (DACs). The plans must also include an infrastructure build out schedule, funding sources and needs, training plans, and information regarding any other issue that is critical to the success of ZEV buses at the transit agency. Information from the Rollout Plans will help the State in developing incentive funding plans, inform utilities about potential electrical updates, and engage the general public about the environmental benefits of ZEBs.

2. Zero-Emission Bus Purchase Requirements

ZEB purchases for large transit agencies with 100 or more buses would begin in 2023 and for small transit agencies would begin in 2026. Cutaway buses, over-the-road buses (motor coaches) and articulated buses are excluded from the ZEB purchase requirements until January 1, 2026 and would continue to be excluded unless they have passed Altoona testing. Excluded buses could still provide credits toward the ZEB purchase requirement or the waiver, as described below. The number of ZEBs a fleet would be required to purchase and operate would be based on a percentage of new bus purchases. The requirement could be met with ZEBs that are already operating in the fleet from prior purchases. This approach does not require any accelerated bus purchases and remains consistent with normal bus purchase patterns. By 2029, all new bus purchases would need to be ZEBs. The phase-in of ZEB purchase requirement is shown as follows:

- A large transit agency would be required to purchase ZEBs according to the following schedule:
  - Starting January 1, 2023, 25 percent of new buses purchased;
  - Starting January 1, 2026, 50 percent of new buses purchased; and
  - Starting January 1, 2029, 100 percent of new buses purchased.
- A small transit agency would be required to purchase ZEBs according to the following schedule:
  - Starting January 1, 2026, 25 percent of new buses purchased; and
  - Starting January 1, 2029, 100 percent of new buses purchased.

3. Waiver for Early Compliance

To provide further flexibility to the transit agencies and encourage early emission reductions in local communities, staff is proposing to waive the 2023 and 2024 purchase requirements if a large number of ZEBs are voluntarily purchased early. The waiver would be in effect only if the following criteria are met:

- Purchase requirements otherwise effective in calendar year 2023 would be waived if California transit agencies collectively purchase 1,000 or more ZEBs by December 31, 2020; and
- Purchase requirements otherwise effective in calendar year 2024 would be waived if California transit agencies collectively purchase 1,150 or more ZEBs by December 31, 2021.

4. Zero-Emission Mobility Option

The optional zero-emission mobility programs can be used in lieu of ZEB purchase requirements. Eligible programs may use bicycles, zero-emission cars or vans, or other zero-emission vehicles with a GVWR of 14,000 lbs. or less. The services must be operated directly by the transit agency or operated by a contractor to the transit agency, and the transit agency must be able to track and record the annual zero-emission passenger miles for each vehicle. A metric for determining equivalence to a ZEB would be based on the actual zero-emission passenger miles each year. A multiplier of three is applied to passenger miles by bicycles to further encourage first- and last-mile connectivity.

- For a large transit agency, every 320,000 zero-emission passenger miles per year is equivalent to having one ZEB in the fleet.
- For a small transit agency, every 180,000 zero-emission passenger miles per year is equivalent to having one ZEB in the fleet

In the event that a transit agency deferred ZEB purchases in one year, but the zero-emission mobility program is downsized or terminated, the transit agency is required to make up the ZEB purchase in the immediate next bus purchase.

This option would complement regional plans for developing sustainable communities. The emission benefits of using this option are similar to purchasing ZEBs and would be expected to be used by transit agencies if they find the option to be advantageous and could be implemented at a lower cost than purchasing ZEBs.

5. Zero-Emission Bus Bonus Credit

Bonus credits would also be given for early deployments of FCEBs and BEBs to reward pioneers and as a recognition of their contribution to supporting zero-emission

technologies. The following bonus credits are available to the transit agencies that have procured ZEBs in advance of these requirements:

- Two bonus credits for each FCEB placed in service on or before December 31, 2017;
- One bonus credit for each BEB placed in service on or before December 31, 2017; and
- One bonus credit for each FCEB placed in service between January 1, 2018 and January 1, 2023.
- Bonus credits cannot be used towards the ZEB accounting in the wavier option for early compliance.

Each bonus credit could be used towards meeting future purchase requirement of one ZEB. ZEB bonus credits may not be used toward the waiver for early compliance and may not be transferred to another transit agency. If a transit agency owning bonus credits participates in a Joint Zero-Emission Bus Group (Joint Group) (see below), this transit agency may choose to use its bonus credits to meet the compliance obligation for the Joint Group. All bonus credits would expire on January 1, 2029 when the 100 percent ZEB purchase requirement begins.

6. Optional Joint Zero-Emission Bus Group

Two or more transit agencies may pool their resources together and form a Joint Zero-Emission Bus Group to collectively comply with ZEB purchase requirement. These transit agencies must share the same Metropolitan Planning Organization (MPO),[51] transportation planning organization, or be located within the same air basin.

Interested transit agencies may submit a notification to the Executive Officer and include a list of all participating transit agencies, the reason they are qualified for this option, a statement of intent, and the proposed start year and the end date (if known). Members of a Joint Group may submit one ZEB Rollout Plan that is approved by each participating transit agency's governing board in lieu of submitting individual plans.

Participating transit agencies must collectively purchase and operate at least the same total number of ZEBs annually as they would if complying individually. They may be able to more effectively deploy ZEBs and the associated infrastructure than if working independently. Members of a Joint Group that are requesting a deferral from ZEB

[51] An MPO is the policy board of an organization created and designated to carry out the metropolitan transportation planning process. MPOs are required to represent localities in all urbanized areas (UZAs) with populations over 50,000, as determined by the U.S. Census. An MPO channels federal funding for transportation projects and programs through its planning process. *See* 49 U.S.C. section 5303(b)(2).

purchase requirements must show that compliance requirements cannot be met by any member of the joint group.

7. Use of Low -NOx Engines

Starting January 1, 2020, small and large transit agencies would be required to purchase low- NOx engines if they are available when new conventional internal combustion engine bus purchases are made. The requirement applies to engines that have been commercially available for at least two years. The engine must be certified to the lowest level of NOx emissions that is suitable for the bus and fuel type being purchased and does not require any action if low-NOx engines are not available for a bus. The requirement would not apply to buses that are dispatched from areas defined as NOx exempt areas.[52,53] Any early low-NOx engine purchases will count towards compliance with the low-NOx engine requirement.

8. Use of Renewable Fuels

Starting January 1, 2020, large transit agencies would be required to use renewable fuels for diesel and CNG buses when fuel contracts are renewed to support existing programs. Transit agencies' use of renewable diesel (RD) and renewable natural gas (RNG) would not produce additional emission reduction outside of the Low Carbon Fuel Standard (LCFS) program. However, such requirement would help stimulate the LCFS market. The proposed ICT regulation does not claim any emission reduction benefits from the use of renewable fuels since the proposed ICT is not the primary driver for this fuel production.

9. Deferral from Zero-Emission Bus Purchase Requirements

In recognition that every transit fleet is different, the regulation includes provisions for deferral of ZEB purchases to address individual fleet situations. The provisions are intended to address circumstances beyond transit agencies' control, and to safeguard

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[52] 50. California Air Resources Board (CARB) (2017). Truck and Bus Regulation NOx Exempt Area Extensions. Last Updated December 21, 2017. Available: https://www.arb.ca.gov/msprog/onrdiesel/documents/fsnoxexempt.pdf.

[53] "NOx Exempt Areas" means the following counties: Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Eastern Kern (portion of Kern County within the Eastern Kern Air Pollution Control District), Glenn, Humboldt, Inyo, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Monterey, Nevada, Northern Sonoma, Plumas, San Benito, San Luis Obispo, Santa Barbara, Santa Cruz, Shasta, Sierra, Siskiyou, Northern Sutter (portion of Sutter County that is north of the line that extends from the south east corner of Colusa County to the southwest corner of Yuba County), the portion of El Dorado that is within the Lake Tahoe Air Basin, the portion of Placer that is East of Highway 89 or within the Lake Tahoe Air Basin, Trinity, Tehama, Tuolumne, and Yuba.

infrastructure investments that have been made. A transit agency may submit a request to the Executive Officer for an extension or exemption from ZEB purchase requirements, should there be an event, identified below, beyond the transit agency's control:

- A transit agency may request an extension for any of the following conditions:
  - Delay in the bus delivery is caused by the bus manufacturer;
  - Needed infrastructure is delayed due to a setback of the infrastructure construction schedule; and
  - When available ZEBs cannot meet a transit agency's daily mileage needs for the buses replaced per that purchase.[54]
- A transit agency may request an exemption when a required ZEB type is not available for purchase. It means the ZEB has either not passed the Altoona bus testing or does not meet the requirements of the Americans with Disabilities Act (ADA). In this case a transit agency after approval of the request may, for up to a year, purchase a conventional internal combustion engine bus.

B. Crossover with Other Programs

California faces challenging goals for public health and climate protections. To achieve these goals, a number of actions have been initiated by the legislature, CARB, and other state agencies. These various actions and directives work together to ensure the State achieve its goals and meets federal mandates.

The CARB LCFS [55] program reduces the carbon intensity of California fuels via market-based mechanisms that also creates an incentive to use renewable and low-carbon fuels. The program requirements reduce the carbon intensity of transportation fuels by about 10 percent by 2020 and is being amended to further reduce the carbon intensity 20 percent by 2030 and maintain the 2030 level for post 2030. The initial Board hearing was held in April 2018 and a final Board decision is expected later this year.

When doing emission reductions accounting, the LCFS program recognizes the need to isolate the effects of the LCFS from outcomes that would have occurred without the regulation, the baseline includes existing regulations and trends that influence the types

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[54] Society of Automotive Engineering (SAE) International (2002). Recommended Practice for Measuring Fuel Economy and Emissions of Hybrid-Electric and Conventional Heavy-Duty Vehicles J2711_200209. Issued September, 2002.

[55] California Air Resources Board (CARB) (2018). Public Hearing to Consider Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels. Staff Report: Initial Statement of Reasons. Date of Release: March 6, 2018. Available: https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf.

and carbon intensities of transportation fuels consumed in California. The major regulations and trends include programs like the Advanced Clean Car program that fosters the market of electric cars. This LCFS accounting policy was stated in the LCFS Initial Statement of Reasons (ISOR) for the 2015 Rule re-adoption.[56] Using the same logic, the proposed ICT accounts for the emission reduction benefit from ZEB deployment but not from the use of renewable fuels on internal combustion engine buses.

Senate Bill 350 (SB 350)[57] and Senate Bill 375 (SB 375)[58] have related but separate actions that contribute to the effectiveness and enhance the benefits of the proposed ICT regulation. SB 350 provided a number of directives to state agencies to support its goals of GHG reduction and transportation system electrification. Among them, the CPUC is directed to oversee Investor-Owned Utilities (IOUs) investment in transportation electrification through their core competencies, primarily charging equipment and upstream electrical infrastructure. Utility-developed infrastructure programs are an important complement that will ease financial challenges facing transit agencies subject to the proposed ICT regulation.

SB 375 creates initiatives for increased development of transit-oriented communities and better-connected transportation and active transportation. The SB 375 program, while related to public transit, is aimed at achieving broader system efficiencies through integrated land-use, housing, and transportation infrastructure planning. Emissions benefits related to the deployment of ZEBs are still attributable to the proposed ICT regulation.

CARB adopted California Phase 1[59] heavy-duty vehicle emission standards in 2014 and staff proposed Phase 2[60] standards in 2018 to mitigate GHG emissions from on-road medium- and heavy-duty engines and vehicles, including trailers. Both Phase 1 and

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[56] California Air Resources Board (CARB) (2014). Proposed Re-Adoption of the Low Carbon Fuel Standard. Staff Report: Initial Statement of Reasons for Proposed Rulemaking. Available: https://www.arb.ca.gov/regact/2015/lcfs2015/lcfs15isor.pdf. Accessed June 29, 2018.

[57] SB-350 Clean Energy and Pollution Reduction Act of 2015, stats. 2015, ch. 547. Available: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.

[58] SB-375 Transportation Planning: Travel Demand Models: Sustainable Communities Strategy: Environmental Review, stats. 2008, ch. 728. Available: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080SB375.

[59] California Air Resources Board (CARB) (2014). Heavy-Duty GHG Phase 1 2013. Last Reviewed December 18, 2014. Available: https://www.arb.ca.gov/regact/2013/hdghg2013/hdghg2013.htm.

[60] California Air Resources Board (CARB) (2017). Phase 2 and Tractor-Trailer Amendments Regulation. Last Reviewed December 19, 2017. Available: https://www.arb.ca.gov/regact/2018/phase2/phase2.htm.

Federal Phase 2 regulations offer credit multipliers for advanced vehicle technologies (e.g., plug-in hybrid, BEB and FCEB) to encourage the introduction of near-zero and zero-emission vehicles into the marketplace. Bus manufacturers could comply by producing only a small portion of advanced zero emission transit buses and take advantage of advanced technology credits to compensate for other transit buses that are certified with the federal Phase 2 custom chassis provisions[61]. The proposed transit bus custom chassis provision in California would incentivize the introduction of advanced zero-emission technology in the transit bus sector. However, the proposed ICT regulation has more aggressive requirements in ZEB purchases. Therefore, the GHG emission reductions due to ZEBs should be attributable to the proposed ICT regulation.

C. Funding Opportunities

The upfront capital costs of ZEBs and related infrastructure currently remain a major barrier for the widespread adoption of ZEBs. Incentives are an important part of a successful launch of the zero-emission technologies. The State is committed to incentives to help with transition to zero-emission technologies. There are several major funding programs established to reduce the incremental costs associated with zero-emission technologies. Some of these funding programs require early or extra action with respect to a regulatory requirement to access funding. Staff's proposal provides sufficient time and opportunities for transit agencies to access funding, and to deploy ZEBs in a manner that is consistent with a transit agency's normal bus purchase schedule. Some of the funding programs mentioned in this section are funding opportunities, not commitments. Some of them are competitive. They also fund a variety of transportation projects other than transit projects.

1. Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

CARB oversees a major funding program, the HVIP, to help the state transition to advanced clean technologies. This program is intended to encourage and accelerate the deployment of zero-emission trucks and buses, hybrid trucks and buses, and vehicles using engines that meet the optional low-NOx standard.

Transit agencies have been using HVIP for ZEB purchases. For FY 2017-2018, the State budget allocated up to $180 million for the program. Of the $180 million allocation, $35 million must be set aside to fund ZEBs. The remaining balance of $145

[61] United States Environmental Protection Agency (U.S. EPA) (2016). Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2. Final Rule. October 25, 2016. Available: https://www.gpo.gov/fdsys/pkg/FR-2016-10-25/pdf/2016-21203.pdf.

million is available on a first-come, first-served basis for all eligible technologies. An additional $125 million has been allocated to the HVIP program per the State Budget Act for FY 2018-2019.[62]

The amount of a voucher for a ZEB depends on the bus length, the type of zero-emission technology, and the location of the vehicle deployed. The voucher amounts are intended to fully cover the incremental cost for a low-NOx engine, the majority of the incremental cost of a BEB, and about half of the incremental cost of a FCEB.[63] The voucher amounts are higher for ZEBs benefiting disadvantaged communities.[64] Additional amounts could be available to assist with needed infrastructure including up to $30,000 for chargers, and up to $100,000 per bus for the purchase of five or more FCEBs. Table III-1 shows the ZEB voucher amounts. Similar funding amounts are proposed for FY 2018-2019.[65] As the incremental costs for ZEBs decline, the voucher amounts per ZEB are expected to decline over time. Since HVIP's inception in FY2009-2010, as of April 2018, the program has helped pay for 47 ZEBs from eight transit agencies. As of April 2018, there are additional requests for HVIP for 139 ZEBs from nine transit agencies.

[62] Senate Bill 856, stats. 2018, ch. 30. Available: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB856.

[63] California Air Resources Board (CARB) (2017). Proposed Fiscal Year 2017-18 Funding Plan for Clean Transportation Incentives, released November 2017. Released November 9, 2017. Available: https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1718_funding_plan_final.pdf.

[64] Up to $15,000 more for use in a disadvantaged community.

[65] California Air Resources Board (CARB) (2018). Public Workshop on the Fiscal Year 2018-19 Funding Plan for Clean Transportation Incentives. Low Carbon Transportation Investments and Air Quality Improvement Program. Discussion Document. Release June 1, 2018. Available: https://www.arb.ca.gov/msprog/aqip/fundplan/060118_discussion_doc.pdf.

Table III-1: Zero-Emission Transit Bus Voucher Amounts (FY2017-2018)

Bus Length and Bus Type	Base Vehicle Incentive*		Voucher Enhancements for Infrastructure
	Outside Disadvantaged Community	In Disadvantaged Community	
20 ft - 24 ft BEB	$80,000	$90,000	Up to $30,000 per BEB
25 ft - 29 ft BEB	$90,000	$100,000	
30 ft - 39 ft BEB	$120,000	$135,000	
40 ft - 59 ft BEB	$150,000	$165,000	
≥ 60 ft BEB	$175,000	$190,000	
≥ 40 ft FCEB	$300,000	$315,000	Up to $100,000 per FCEB with purchase of 5 or more FCEBs

* The incentive amounts are for 1 to 100 vehicles.

2. Federal Low or No Emission Vehicle Program

The Low or No emission (Low-No) program[66], funded by the Federal Transit Administration as a discretionary fund, provides funding for transit agencies for capital acquisitions and leases of zero-emission and low emission transit buses, including acquisition, construction, and leasing of required supporting facilities such as recharging, refueling, and maintenance facilities. Under the Fixing America's Surface Transportation (FAST) Act, the program provides $55 million per year for the nation and is available until FY 2020.[67] The Low-No program is a competitive program. The funding amounts awarded to California transit agencies vary each year. In 2016, of the

[66] Federal Transit Administration (FTA). Low or No Emission Vehicle Program - 5339(c). Available: https://www.transit.dot.gov/funding/grants/lowno.

[67] Federal Transit Administration (FTA) (2017). Fixing America's Surface Transportation (FAST) Act. Updated February 22, 2017. Available: https://www.transit.dot.gov/FAST.

20 transit agencies that were awarded funding, five were California transit agencies.[68] In 2017, 5 out of 51 Low-No recipients were California transit agencies.[69]

3. California Low Carbon Transit Operations Program

The Low Carbon Transit Operations Program (LCTOP)[70], administered by the California Department of Transportation (Caltrans), was created to provide operating and capital assistance for transit agencies to reduce GHG emissions and improve mobility, with a priority on serving disadvantaged communities. In addition to supporting the purchase of ZEBs and the installation of the related infrastructure, LCTOP supports new or expanded bus or rail services, new or expanded water-borne transit, and expanded intermodal transit facilities, and may also include funding for equipment acquisition, fueling, maintenance and other costs to operate those services or facilities. In addition, operational expenditures that increase transit mode share are also eligible for funding under LCTOP.[71]

SB 862 established LCTOP as a noncompetitive, formulaic program, with 5 percent of the annual Cap-and-Trade auction proceeds from the Greenhouse Gas Reduction Fund (GGRF) continuously appropriated at the beginning of 2015. LCTOP funds are distributed based on prior use of State Transit Assistance (STA) funds, where 50 percent of the funds are designated to regional entities and the other 50 percent for transit operators.[72]

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[68] Federal Transit Administration (FTA) (2017). Fiscal Year 2016 Low or No-Emission (Low-No) Bus Program Projects. Updated September 13, 2017. Available: https://www.transit.dot.gov/funding/grants/fiscal-year-2016-low-or-no-emission-low-no-bus-program-projects.

[69] Federal Transit Administration (FTA) (2018). Fiscal Year 2017 Low or No-Emission (Low-No) Bus Program Projects. Updated March 22, 2018. Available: https://www.transit.dot.gov/funding/grants/fiscal-year-2017-low-or-no-emission-low-no-bus-program-projects.

[70] California Department of Transportation (Caltrans). Low Carbon Transit Operations Program (LCTOP). Available: http://www.dot.ca.gov/drmt/splctop.html.

[71] California Department of Transportation (Caltrans) (2018). Low Carbon Transit Operations Program FY 2017-2018 Final Draft Guidelines. January 2018. Available: http://www.dot.ca.gov/drmt/docs/lctop/1718final_draft_guidelines3.pdf.

[72] California Department of Transportation (Caltrans) (2018). Low Carbon Transit Operations Program FY 2017-2018 Final Draft Guidelines. January 2018. Available: http://www.dot.ca.gov/drmt/docs/lctop/1718final_draft_guidelines3.pdf.

The LCTOP awarded to 125 projects in the FY 2016-2017.[73] Of the 125 awarded projects, 15 projects are related to ZEB programs, which account for about 12 percent of the total awarded amount of $34.5 million. For FY 2017-2018, nearly $97 million was awarded to 152 public transportation projects, which include 32 projects for purchasing a total of 74 ZEBs or related infrastructure.[74]

4. California Transit and Intercity Rail Capital Program

The Transit and Intercity Rail Capital Program (TIRCP), administered by the California State Transportation Agency (CalSTA), provides funding for transformative capital improvements that will modernize California's intercity, commuter, and urban rail systems, as well as bus and ferry transit systems, to significantly reduce GHG emissions, vehicle miles traveled, and traffic congestion. [75]

TIRCP receives both a specified portion of annual SB 1 revenues, and 10 percent of the annual Cap-and-Trade auction proceeds from the GGRF. SB 9 requires the grant cycle to approve a five-year program of projects starting with FY 2018-2019. Funding for this five-year cycle may significantly increase due to the legislation passed in 2017. First, SB1 provides a funding increase for transportation with an estimated $1.4 billion directed to TIRCP from the Public Transportation Account for new programming in the cycle. Second, AB 398 extended the Cap-and-Trade Program from 2020 through 2030, potentially providing an estimated $1 billion in GGRF to this program during the programming period of FY 2018-2019 through FY 2022-2023. However, funding from both sources are subject to impacts from market forces.[76]

In the 2018 TIRCP applications, there were 47 projects submitted by 40 agencies. TIRCP 2018 awards have 28 recipients with a total of $2.65 billion for the period from

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[73] California Department of Transportation (Caltrans) (2017). News release. More Than $34 Million Awarded to 125 Projects Under Cap-and-Trade Fund. July 3, 2017. Available: http://www.dot.ca.gov/drmt/docs/lctop/fy1617award_list.pdf.

[74] California Department of Transportation (Caltrans) (2018). News release. Nearly $97 Million Awarded to 152 Public Transportation Projects Under Cap-and-Trade Fund. July 10, 2017. Available: http://www.dot.ca.gov/drmt/docs/lctop/2018list.pdf.

[75] California State Transportation Agency (CalSTA) (2017). 2018 Transit and Intercity Rail Capital Program Guidelines. October 13, 2017. Available: http://www.dot.ca.gov/drmt/docs/sptircp/2018finalgl.pdf.

[76] California State Transportation Agency (CalSTA) (2017). 2018 Transit and Intercity Rail Capital Program Guidelines. October 13, 2017. Available: http://www.dot.ca.gov/drmt/docs/sptircp/2018finalgl.pdf.

FY 2018-2019 to FY 2022-2023. Awarded projects include the purchase of 298 ZEBs and associated infrastructure from 12 agencies.[77]

5. Volkswagen Environmental Mitigation Trust

The Volkswagen (VW) Environmental Mitigation Trust provides about $423 million for California to mitigate the excess NOx emissions caused by VW's use of illegal defeat devices in certain diesel vehicles.[78] The Trust provides funding opportunities for specified eligible actions that are focused mostly on "scrap and replace" projects for the heavy-duty sector, including on-road freight trucks, transit and shuttle buses, school buses, forklifts and port cargo handling equipment, commercial marine vessels, and freight switcher locomotives. CARB has been designated as Lead Agency to act on the State's behalf in implementing California's allocation of the VW Environmental Mitigation Trust. As the Lead Agency, CARB has developed a proposed Beneficiary Mitigation Plan with public input that describes how California's Trust allocation would be spent. Staff has proposed to allocate $130 million for zero-emission transit, school, and shuttle bus replacements, with at least 50 percent of the allocation expected to benefit disadvantaged or low-income communities.[79] The Board approved the proposed plan at the public meeting on May 25, 2018. Staff will begin implementation of the plan in the summer of 2018, starting with stakeholder workgroup meetings to determine appropriate per-vehicle funding amounts, reporting requirements, and other implementation details.

6. Senate Bill 350 – Clean Energy and Pollution Reduction Act of 2015

California Senate Bill (SB) 350 provides a potential opportunity of transportation electrification including ZEBs. The CPUC is collaborating with CARB and the California Energy Commission (CEC) to implement requirements set forth by SB 350 to support widespread transportation electrification. Most recently, the CPUC unanimously approved two large-scale medium- and heavy-duty transportation electrification programs: Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) will spend $236 million and $343 million, respectively, to install infrastructure needed to

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[77] California State Transportation Agency (CalSTA) (2018). Transit and Intercity Rail Capital Program 2018 Awards. April 26, 2018. Available: http://www.dot.ca.gov/drmt/docs/sptircp/2018_awardlist.pdf.

[78] California Air Resources Board (CARB) (2018). Volkswagen Settlement - Environmental Mitigation Trust for California. Last Updated June 28, 2018. Available: https://www.arb.ca.gov/msprog/vw_info/vsi/vw-mititrust/vw-mititrust.htm.

[79] California Air Resources Board (CARB) (2018). Proposed Beneficiary Mitigation Plan for the Volkswagen Environmental Mitigation Trust. April 20, 2018. Available: https://www.arb.ca.gov/msprog/vw_info/vsi/vw-mititrust/meetings/proposed_bmp.pdf.

support medium- and heavy-duty electric vehicles, each over five-year programs. [80,81] These programs are designed to install infrastructure to support at least 6,500 vehicles at 700 sites in PG&E's territory and at least 8,490 vehicles at 870 sites in SCE's service territory. The CPUC's decision also provides for rebates for charging stations at sites that support electric transit buses.

Several of the pilot programs approved by the CPUC in January 2018 also focus on medium- and heavy-duty sectors.[82] These programs will not only install necessary electric infrastructure but will also test load management strategies and rate designs to support the electrification of medium- and heavy-duty fleets, including transit buses.

San Diego Gas & Electric (SDG&E) has proposed to spend another $150 million on medium- and heavy-duty infrastructure through a program currently under CPUC review.

7. Carl Moyer Memorial Air Quality Standards Attainment Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) is a grant program that funds the incremental cost of cleaner-than-required engines, equipment, and other sources of air pollution. This program complements CARB's regulatory efforts by providing surplus and extra ozone precursors and particulate matter emission reductions. CARB works collaboratively with the local air districts and other stakeholders to set the Guidelines, and the local air districts administer these grants and select which projects to fund.

The minimum criteria and the requirements for on-road heavy-duty vehicles, including transit buses, are described in the Carl Moyer Program Guidelines.[83] The funding amount is based on the cost-effectiveness of a project, the project funding cap, and the project grant amount cap. The 2017 Carl Moyer Program Guidelines provide a zero-

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[80] California Public Utilities Commission (CPUC) (2017). SB 350 Transportation Electrification Applications Overview: Background & Proceeding Process. February 8, 2017. Available: http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442452499.

[81] *Application of San Diego Gas & Electric Company* (U 902E) for Approval of SB 350 Transportation Electrification Proposals (Cal.P.U.C. Decision 18-05-040, May 31, 2018) No. A 17-01-020 and Related Matters A 17-01-021, 17-01-022.

[82] California Public Utilities Commission (CPUC) (2018). Decision on the Transportation Electrification Priority Review Projects. January 11, 2018. Available: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K670/204670548.PDF.

[83] California Air Resources Board (CARB) (2017). The Carl Moyer Program Guidelines 2017 Revisions. Volume 1: Program Overview, Program Administration and Project Criteria. April 27, 2017. Available: https://www.arb.ca.gov/msprog/moyer/guidelines/2017gl/2017_cmp_gl_volume_1.pdf.

emission conversion or replacement project grant amount based on a $100,000 per weighted ton cost-effectiveness limit for emission reductions beyond the current 0.2 g/bhp-hr NOx standard. The funding cap for zero-emission replacement or conversion for a transit bus is $80,000. The project life factors into the grant amount and must be surplus to regulatory requirements.

The Moyer Program also covers infrastructure projects. Public transit buses are eligible to receive infrastructure funding up to 50 percent of a hydrogen station or a battery charging station. Eligible costs include design and engineering fees, cost of equipment, and installation costs. Unlike vehicle projects, infrastructure projects are not required to meet a cost-effectiveness limit.

8. Assembly Bill 617 Community Air Protection Funds

In 2017, Governor Brown signed into law Assembly Bill (AB) 617 (Chapter 136, Statutes of 2017) which directs CARB, in conjunction with local air quality management districts and air pollution control districts, to establish the Community Air Protection Program. This bill directs CARB to establish community air monitoring plans for toxic air contaminants and criteria pollutants, determine communities most affected by high cumulative exposure burden, and develop strategies to reduce emissions in those communities.

Assembly Bill 134 (Chapter 14, Statutes of 2017) appropriates $250 million in GGRF to achieve early action emission reductions in the communities most burdened by air pollution. Targeting engine replacement, repower, and infrastructure projects in disadvantaged and low income areas supports the goals of AB 617. These Community Air Protection funds, distributed through the air districts, are to be spent on projects under the Carl Moyer Program with focus on mobile sources and infrastructure (Districts in designated trade corridors may opt to spend up to 40 percent of the funds on clean truck projects under the Proposition 1B Goods Movement Guidelines). The local air districts select projects to fund following public outreach in disadvantaged communities. An additional $245 million has been appropriated by the State Budget Act of 2018.

The Board recently approved a Community Air Protection Supplement to the 2017 Moyer Program Guidelines with several specific revisions that will better allow air districts and CARB to better serve community needs and to support AB 617.[84] Changes relevant to ZEBs include:

[84] California Air Resources Board (CARB) (2018). Community Air Protection Funds to Reduce Emissions in AB 617 Communities. Last Reviewed April 6, 2018. Available:

- Removal of funding caps for all zero-emission on-road projects, including shuttles and buses;
- An increase in the maximum percentage of the project cost that Moyer can pay for vehicle and equipment projects. For zero-emission buses and trucks the increase is from 80 percent of the project cost to 95 percent for fleets with 3 or fewer vehicles, from 80 percent to 90 percent for fleets with more than 3 vehicles but no more than 10, and from 50 percent to 60 percent for fleets with more than 10 vehicles;
- An increase in the maximum percentage of the project cost Moyer can pay for infrastructure projects, from a baseline of 50 percent to 60 percent (and up to 100 percent at sensitive receptor locations); and
- Priority for zero-emission technology whenever feasible, with a focus on funding vehicles and equipment that actually operate within disadvantaged communities.

https://www.arb.ca.gov/msprog/cap/capfunds.htm?_ga=2.103899016.923410871.1525897833-138148794.1501775822.

IV. AIR QUALITY

This chapter summarizes the potential air quality impacts in California in response to the proposed ICT regulation. This chapter includes the following elements: (1) an overview of the emission inventory methods; (2) description of baselines used to estimate emission benefits of the proposed ICT regulation; and (3) changes of emissions due to the proposed ICT regulation, including tailpipe NOx and $PM_{2.5}$ emissions and well-to-wheel (WTW) GHG emissions. The details of the emission inventory development are discussed in Appendix L.

A. Emission Inventory Methods

Staff used the latest available data on population, activity and in-use emissions from transit fleets operating in California to estimate baseline emissions and assess the impact of proposed and alternative scenarios on both criteria (NO_X and $PM_{2.5}$) and GHG emissions:

(1) First, staff estimated current transit bus population and their VMT in 2016 using latest data from the NTD, and generated a baseline scenario, "current conditions", by projecting the population and activity to future years.
(2) In addition to the baseline inventory with current conditions, staff also assessed the effects of the proposed ICT regulation as well as other alternative scenarios.
(3) Finally, staff produced emissions inventories for all scenarios by running the EMFAC2017 model[85] to estimate tank-to-wheel emissions. For GHG, WTW emissions were also estimated using emission rates derived from the Vision model 2.1.[86]

B. Baseline Information

As described in Chapter VIII and Appendix B, the economic impact of the proposed ICT regulation is evaluated against two scenarios that were developed in consultation with the Department of Finance (DOF). One of the scenarios is referred to as the "baseline", which reflects a situation where the same number of ZEBs are purchased as originally envisioned with the existing regulation, and the other is referred to as "current

[85] California Air Resources Board (CARB) (2018). Mobile Source Emissions Inventory, EMFAC2017. Last Updated March 1, 2018. Available: https://www.arb.ca.gov/msei/msei.htm.

[86] California Air Resources Board (CARB) (2017). Vision Scenario Planning: Downloads, 2016 Vision 2.1 Limited Release. Last Reviewed February 15, 2017. Available: https://www.arb.ca.gov/planning/vision/downloads.htm.

conditions," which reflects CARB's advisory and the real-world conditions today, including the Board's direction to delay the purchase requirement.

In this staff report, the estimated emission benefits of the proposed ICT regulation against the "current conditions" is presented, since that reflects actual conditions. The analysis against the "baseline" is shown in Appendix I.

C. Emission Inventory Results

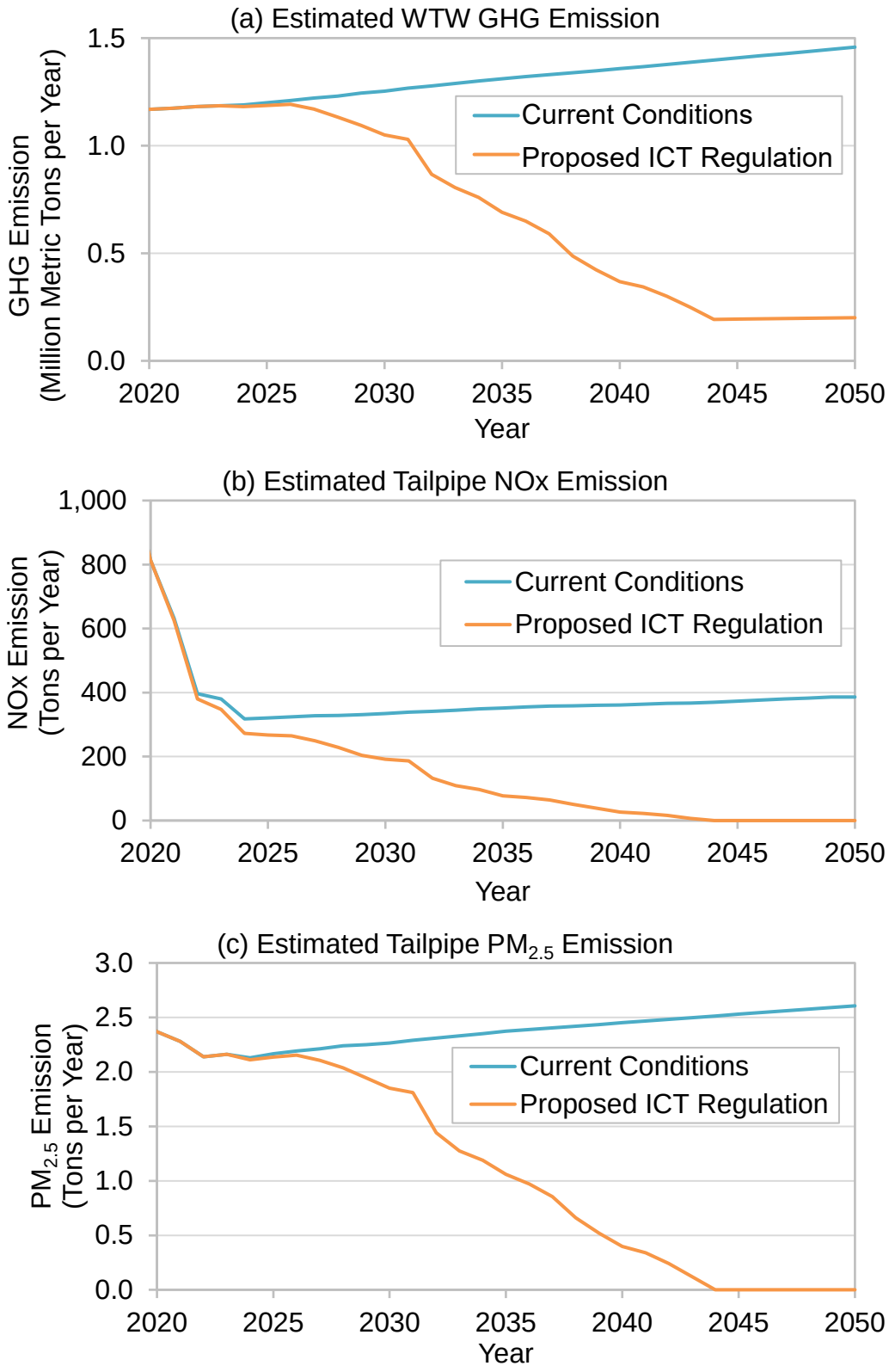
The ICT regulation is expected to result in GHG, $PM_{2.5}$, and NOx emission reductions after adoption. Replacing conventional internal combustion engine buses with ZEBs would result in GHG, NOx, and $PM_{2.5}$ emission reduction benefits. Low-NOx engine purchases would result in additional NOx emission reduction benefits.

Figure IV-1 summarizes the WTW GHG and the tailpipe NOx and $PM_{2.5}$ emission projections under current conditions and the proposed ICT regulation scenario.

Relative to current conditions, the proposed ICT regulation is expected to cumulatively reduce GHG emissions by 19 million metric tons of carbon dioxide equivalent (MMT CO_2e) from 2020 to 2050. For tailpipe NOx and $PM_{2.5}$, the proposed ICT regulation is expected to result in an estimated 7,032 tons and 39.4 tons emission reductions, respectively. In addition, the ZEB technologies will assist the future advanced technology deployment in other heavy-duty on-road sectors to further help achieve the emission reduction goals identified in the State SIP Strategy. [87]

[87] California Air Resources Board (CARB) (2017). Revised Proposed 2016 State Strategy for the State Implementation Plan (State SIP Strategy). March Available: https://www.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf.

Figure IV-1: Emission projections of WTW GHG, and tailpipe NOx and $PM_{2.5}$ under Current Conditions and Proposed ICT regulation



V. BENEFITS ANTICIPATED FROM THE REGULATORY ACTION, INCLUDING THE BENEFITS OR GOALS PROVIDED IN THE AUTHORIZING STATUTE

A. Air Quality and Climate Benefits

The demanding air quality and climate protection goals that California faces require cleaner technologies deployed especially in the transportation sector. The proposed ICT regulation helps reduce emissions through several ways:

(1) Increase fuel efficiency and thereby reduce the use of energy which may be sourced through a combustion process;
(2) Better utilize non-emitting renewable sources such as solar energy;
(3) Eliminate tailpipe emissions and excess emissions caused by deteriorated vehicles;
(4) Reduce emissions from the oil and gas extraction and production processes; and
(5) For the near-term, pair with the use of low-NOx engines for additional NOx emission reduction.

The details of the air quality benefits are shown in Chapter IV.

B. Health Benefits for Californians and Transit Agency Workers

The proposed ICT regulation reduces NOx and $PM_{2.5}$ emissions, resulting in health benefits for Californians, including the transit agency staff operating and serving the transit buses. The values of these health benefits are created due to fewer instances of premature mortality, fewer hospital and emergency room (ER) visits, and fewer lost days of school and work. As part of setting the National Ambient Air Quality Standard for PM, the U.S. EPA quantifies the health risk from exposure to PM[88], and CARB relies on the same health studies for this staff report. The method to estimate health benefits used in this analysis is the same as the one used for CARB's proposed Low Carbon Fuel Standard 2018 Amendments[89], and Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program. [90]

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[88] United State Environmental Protection Agency (U.S. EPA) (2010). Quantitative Health Risk Assessment for Particulate Matter. June 2010. Available: https://www3.epa.gov/ttn/naaqs/standards/pm/data/PM_RA_FINAL_June_2010.pdf.

[89] California Air Resources Board (CARB) (2017). Low Carbon Fuel Standard 2018 Amendments. Standardized Regulatory Impact Assessment (SRIA). November 16, 2017. Available: http://www.dof.ca.gov/Forecasting/Economics/Major_Regulations/Major_Regulations_Table/documents/LCFS_SRIA_CARB_11-16-17.pdf.

[90] California Air Resources Board (CARB) (2017). Proposed Regulatory Amendments to the Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program. Standardized Regulatory Impact Assessment (SRIA). August 10, 2017. Available:

The largest estimated health benefits correspond to regions in California with the most transit buses such as South Coast Air Basin and San Francisco Bay Air Basin, with minor health benefits distributed among other regions. Table V-1 shows the estimated avoided mortality and morbidity incidence because of the proposed ICT regulation for 2020 through 2050 by California air basin, relative to the current conditions. Only the regions with values of 1 or higher are shown; regions with zero or insignificant impacts are not shown. Values in parenthesis represent the 95 percent confidence intervals of the central estimate. As shown in Chapter IV, compared to current conditions, the proposed ICT regulation is estimated to reduce emissions of $PM_{2.5}$ and NOx in all years after 2020, and lead to a net statewide health benefit.

In addition to reducing emissions in local communities and bringing immediate health benefits to sensitive receptors, the proposed ICT regulation could also decrease the occupational exposure of California bus operators, technicians, passengers, and workers who work around bus traffic. CARB staff does not quantify the potential effect on occupational exposure due to lack of data on the typical occupational exposure for these types of works.

Table V-1: Incremental Regional and Statewide Avoided Mortality and Morbidity Incidences from 2020 to 2050 under the Proposed ICT regulation Scenario

Region	Avoided Premature Deaths	Avoided Hospitalizations	Avoided ER Visits
Sacramento Valley	3 (2-4)	0 (0-1)	1 (1-2)
San Diego County	3 (2-4)	0 (0-1)	1 (1-2)
San Francisco Bay	8 (6-9)	1 (0-3)	3 (2-5)
San Joaquin Valley	5 (4-6)	1 (0-1)	2 (1-3)
South Coast	30 (23-36)	4 (1-10)	13 (8-18)
Statewide*	50 (39-61)	8 (1-17)	21 (14-29)

* Numbers may not add-up because of rounding

C. Energy Saving and Reduction of Petroleum Fuel Dependence

In the long term, implementation of the proposed ICT regulation will lead the way in the heavy-duty vehicle sector to enable fuel switching from petroleum and other fossil-based fuels toward hydrogen or electricity for public transportation. The Clean

http://www.dof.ca.gov/Forecasting/Economics/Major_Regulations/documents/CARB%20HDVIP%20PSIP%20SRIA.pdf.

Energy and Pollution Reduction Act of 2015,[91], and SB 1505[92] together ensure the renewable attributes in both grid electricity and transportation use hydrogen. To date, California is on track of achieving both targets.[93,94]

The wise and efficient use of energy will decrease overall per capita energy consumption, decreasing reliance on fossil fuel such as coal, natural gas, and oil, and increasing reliance on renewable energy sources. The fuel efficiency of ZEBs is higher than that of conventional internal combustion engine buses (diesel, gasoline, CNG, and propane buses). The average fuel efficiency for BEBs is about three to five times as much of that for conventional internal combustion engine buses and the average fuel efficiency for FCEBs is about two times as much. The superb fuel efficiency of ZEBs and their alternative fuel sources together help pave a low carbon future for the heavy-duty vehicle sector.

In addition to benefits associated with vehicle technology and fuel switching, the proposed ICT regulation would also incentivize other zero-emission mobility options for transit agencies better design transit service to improve mobility. The zero-emission mobility option can further reduce energy consumption and petroleum use, enhance innovative mobility strategies, and improve efficiency in the public transit system.

D. Leading Zero-Emission Technologies in Other Heavy-Duty Sectors

Transit agencies have always played a vital role as leaders in the deployment of cleaner, more efficient technologies in the heavy-duty vehicle sector. Examples include diesel particulate matter filters, CNG engines, low-NOx engines, etc. There is no inherent difference when it comes to zero-emission technologies. Technology transferability can be demonstrated in the following areas:

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[91] SB-350 Clean Energy and Pollution Reduction Act of 2015, stats. 2015, ch. 547. Available: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.

[92] SB-1505 Fuel: Hydrogen Alternative Fuel, stats. 2006, ch. 877. Available: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200520060SB1505.

[93] California Public Utilities Commission (CPUC) (2017). California's Renewables Portfolio Standard. Annual Report. November 2017. Available: http://www.cpuc.ca.gov/uploadedFiles/CPUC_Website/Content/Utilities_and_Industries/Energy/Reports_and_White_Papers/Nov%202017%20-%20RPS%20Annual%20Report.pdf.

[94] California Air Resources Board (CARB) (2017). 2017 Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen. August 2017. Available: https://www.arb.ca.gov/msprog/zevprog/ab8/ab8_report_2017.pdf.

1. Vehicle technologies

Transit buses are the ideal candidates for zero-emission technologies. They are usually operated in urban centers often at low speeds with a lot of stop-and-go driving cycles, which are optimal for electric drivetrains and conductive to regenerative breaking. As shown in Figure I-3, they have been deployed and operated in multiple locations. ZEBs would be acting as beachhead in the heavy-duty vehicle sectors. As more transit agencies participate and scale-up the deployment of ZEBs as a result of the proposed ICT regulation, zero-emission technologies will improve and become more mature and thereby be transferred to other applications, such as drayage, yard, and delivery trucks.

2. Fueling and charging needs and strategies

Similar to vehicle technologies, the experience and knowledge of transit agencies with planning and constructing hydrogen and charging infrastructure would provide guidance for other heavy-duty vehicle sectors. For example, with the lessons learned from BEB deployment in Foothill Transit, a fleet owner could benefit from conducting a route analysis and simulating how the battery electric vehicle would meet power and service requirements. The fleet owner could also benefit from working with the local utility to address potential costs for demand and time-of-use charges.

3. Trouble shooting

As pioneers of operating and maintaining ZEBs with battery electric or fuel cell powertrains, transit agencies would experience typical challenges and issues with zero-emission technology including the transition of maintenance from bus manufacturers to transit staff, working with the local utility to address potential costs for demand and time-of-use charges, and maintenance of high voltage batteries and fuel cell power plants. Experiences and skills from identifying and addressing these issues can be shared with other heavy-duty vehicle sectors where zero-emission technologies would be deployed.

E. Benefits in Disadvantaged Community and Job Creation

The proposed ICT regulation is anticipated to deliver environmental benefits that include GHG and criteria pollutant emission reductions in the DAC areas where there are more transit dependent riders.

In addition to reducing emissions, the ZEB industry is bringing high quality employment opportunities to California. There are several ZEB manufacturers with plants located in California, such as BYD Motors Inc., Complete Coach Works, Ebus, ElDorado National-California, GILLIG, GreenPower, and Proterra. As the production of ZEBs increases, so would the number of manufacturing and related jobs for DAC areas. Electricians, construction companies (such as infrastructure installers), some bus manufacturers, fuel

cell and battery producers, and electric drivetrain parts and components suppliers can fall into the small business category.

F. Other Societal Benefits

The proposed ICT regulation would encourage enhanced mobility and connectivity with zero-emission transportation modes. Zero-emission mobility options would enhance and expand access to existing transit service, particularly for populations most dependent on public transit in low-income and disadvantaged communities. These efforts would make communities and cities more sustainable and enhance the benefits of investments in cleaner technologies by reducing growth in light-duty VMT. In the long term, advanced transportation systems and technologies, such as electric vehicles and zero-emission microtransit, have the potential to be a transformative element of a cleaner, safer, and more efficient transportation system.

VI. ENVIRONMENTAL ANALYSIS

CARB is the lead agency for the proposed regulation and has prepared an environmental analysis pursuant to its certified regulatory program (Cal. Code Regs., tit. 17, §§ 60000 through 60008) to comply with the requirements of the California Environmental Quality Act (CEQA). CARB's regulatory program, which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of CEQA (Cal. Code Regs., tit. 14, § 15251(d)) Public Resources Code section 21080.5 , allows public agencies with certified regulatory programs to prepare a "functionally equivalent" or substitute document in lieu of an environmental impact report or negative declaration, once the program has been certified by the Secretary for the Resources Agency as meeting the requirements of CEQA. CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report to comply with CEQA (Cal. Code Regs., tit. 17, § 60005).

The Draft Environmental Analysis (Draft EA) for the proposed regulation is included in Appendix C to this Staff Report. The Draft EA provides a programmatic environmental analysis of an illustrative, reasonably foreseeable compliance scenario that could result from implementation of the proposed ICT regulation.

The Draft EA states that implementation of the proposed ICT regulation could result in beneficial impacts to GHG, PM, and NOx through substantial reductions in emissions from transit buses in California, long-term beneficial impacts to air quality through reductions in criteria pollutants, and beneficial impacts to energy demand.

For the purpose of determining whether the proposed regulation will have a potential adverse effect on the environment, CARB evaluated the potential physical changes to the environment resulting from a reasonable foreseeable compliance scenario for the proposed ICT regulation.

Implementation of the proposed ICT regulation could result in an increase in manufacturing and associated facilities to increase the supply of ZEBs, along with construction of new hydrogen fueling stations and electric vehicle charging stations to support ZEB operations. This could also cause an associated increase in demand for hydrogen fuel supply and transportation. Increased deployment of ZEBs could result in a relatively small increase in production of electricity and hydrogen fuel, reduce rates of oil and gas extraction, and result in associated increases in lithium and platinum mining and exports from source countries or other states. This could also result in increased rates of disposal of lithium batteries and hydrogen fuel cells; however, disposal would

need to comply with California law, including but not limited to California's Hazardous Waste Control Law and implementing regulations. For lithium-ion batteries, it is anticipated they still have a useful life at the end of bus life, and thus are likely to be repurposed for a second life. To meet an increased demand for refurbishing or reusing batteries and fuel cells, new facilities or modifications to existing facilities could be constructed to accommodate recycling activities. Fleet turnover largely would be unaffected since the regulation is implemented at the time of normal bus purchase.

While many impacts associated with the proposed ICT regulation could be reduced to a less-than-significant level through conditions of approval applied to project-specific development, the authority to apply that mitigation lies with land use agencies or other agencies approving the development projects, not with CARB. Consequently, the EA takes the conservative approach in its significance conclusions and discloses, for CEQA compliance purposes, that impacts from the development of new facilities or modification of existing facilities associated with reasonably foreseeable compliance responses to the proposed ICT regulation could be potentially significant and unavoidable. Table VI-1 below summarizes potential impacts of approving the proposed regulation.

Table VI-1: Summary of Potential Environmental Impacts

Resource Area Impact	Significance
Short-Term Construction-Related and Long-Term Operational Impacts on Aesthetics	Potentially Significant and Unavoidable
Conversion of Agricultural and Forest Resources Related to New Facilities	Potentially Significant and Unavoidable
Short-Term Construction-Related Air Quality Impacts	Potentially Significant and Unavoidable
Long-Term Operation Air Quality Emissions	Less than Significant
Short-Term Construction-Related and Long-Term Operational Impacts on Biological Resources	Potentially Significant and Unavoidable
Short-Term Construction-Related and Long-Term Operational Impacts on Cultural Resources	Potentially Significant and Unavoidable
Short Term Construction-Related Impacts on Energy Demand	Less Than Significant
Long-Term Operational Impacts on Energy Demand	Beneficial
Short-Term Construction-Related and Long-Term Operational Effects on Geology and Soil Related to New Facilities	Potentially Significant and Unavoidable

Resource Area Impact	Significance
Short-Term Construction- and Long-Term Operational-Related Greenhouse Gas Impacts	Beneficial
Short-Term Construction-Related and Long-Term Operational Impacts on Hazard Impacts	Potentially Significant and Unavoidable
Short-Term Construction-Related and Long-Term Operational-Related Hydrologic Resource Impacts	Potentially Significant and Unavoidable
Long-Term Effects on Hydrology and Water Quality Related to Changes in Land Use	Potentially Significant and Unavoidable
Short-Term Construction-Related and Long-Term Operational-Related Impacts on Land Use and Planning	Potentially Significant and Unavoidable
Short-Term Construction-Related Impacts on Mineral Resources	Less than significant
Long-Term Operational-Related Impacts on Mineral Resources	Potentially Significant and Unavoidable
Short-Term Construction- and Long-Term Operational-Related Noise Impacts	Potentially Significant and Unavoidable
Short-Term Construction-Related Impacts and Long-Term Operational-Related Impacts on Population, Employment, and Housing	Less Than Significant
Short-Term Construction-Related Impacts and Long-Term Operational-Related Impacts on Public Services	Less Than Significant
Short-Term Construction-Related Impacts and Long-Term Operational-Related Impacts on Recreation	Less Than Significant
Short-Term Construction-Related Impacts on Traffic and Transportation	Potentially Significant and Unavoidable
Long-Term Operational-Related Impacts on Traffic and Transportation	Potentially Significant and Unavoidable
Increased Demand for Water, Wastewater, Electricity, and Gas Services	Potentially Significant and Unavoidable

A Notice of Preparation (NOP) was prepared and made available for review and comment for 30 days, per the CEQA Guidelines (Cal.Code Regs., tit. 14 §15082(b)). The comment period for this NOP began on December 4, 2017 and ended on January 3, 2018. A public workshop that also served as the CEQA scoping meeting to solicit input on the scope and content of the Draft EA was held on December 15, 2017.

Written comments on the Draft EA will be accepted starting August 10, 2018, through 5 p.m. on September 24, 2018. The Board will consider the final EA and responses to comments received on the Draft EA before taking action to adopt the proposed ICT regulation.

VII. ENVIRONMENTAL JUSTICE

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Government Code, section 65040.12, subdivision (c)). CARB is committed to making environmental justice an integral part of its activities. The Board approved its Environmental Justice Policies and Actions (Policies)[95] on December 13, 2001, to establish a framework for incorporating environmental justice into CARB's programs consistent with the directives of state law. These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and disadvantaged communities.

Over the past thirty years, CARB, local air districts, and federal air pollution control programs have made substantial progress towards improving air quality in California and are on track to meet the statutory goals of reducing GHG emissions to 1990 levels by 2020. Despite this progress, some areas in California still exceed health-based air quality standards for ozone and PM. One of the most important factors for identifying disadvantaged communities are disproportionate effects of environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation.

CARB understands that legislation like Senate Bill 350 (De León, Chapter 547, Statutes of 2015) is at the cornerstone of California's future ability to meet air quality, public health, and climate goals, along with ensuring economic prosperity, social equity, and energy security.[96] One key strategy to achieve these goals is by transitioning to zero-emission technologies in all sectors including industrial, residential, electricity, and transportation, as well as cleaner, safer mobility options to allow for connectivity between transit and various clean transportation modes that meet the dynamic needs of low-income and disadvantaged communities. The proposed ICT regulation with a goal of full transition to 100 percent ZEBs and zero-emission mobility options is essential to this strategy.

Transit buses are the predominant means of public transportation service. Their prevalence can be seen along primary transportation corridors as well as in more

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[95] California Air Resources Board (CARB) (2001). Policies and Actions for Environmental Justice. Approved on December 13, 2001. Available: https://www.arb.ca.gov/ch/programs/ej/ejpolicies.pdf.

[96] California Air Resources Board (CARB) (2018). Low-Income Barriers Study, Part B: Overcoming Barriers to Clean Transportation Access for Low-Income Residents. February 21, 2018. Available: https://www.arb.ca.gov/msprog/transoptions/sb350_final_guidance_document_022118.pdf.

densely populated urban areas, including in low-income and disadvantaged communities that are more likely to require additional transportation services to make the first and last mile connections. The proposed ICT regulation requires purchases of ZEBs, the utilization of low-NOx engines, and the use of renewable fuels. These actions in the proposed ICT regulation would ensure public access to the cleanest transit service. Besides, the proposed ICT regulation encourages zero-emission mobility options, which would enhance and expand access to existing transit service, particularly for populations most dependent on public transit in low-income and disadvantaged communities.

CARB recognizes the importance of transforming the state's transportation sector to support widespread electrification of fleets which will allow for ZEB adoption, and will work towards addressing some of the barriers that low-income and disadvantaged communities must overcome in order to achieve equitable access to clean transportation and mobility options. Although many California residents across the state face similar barriers to access clean transportation and mobility options, CARB recognizes that the barriers low-income residents and disadvantaged communities face are magnified for those with limited financial resources and that live in communities with limited transportation options. Therefore, CARB understands the importance of furthering the State's and the public's awareness and understanding of clean transportation and mobility options that are currently available and additionally increasing access to and availability of new zero-emission and near zero-emission transportation options. Implementation of ZEBs and mobility options like active transportation for people's daily needs in these communities would provide substantial benefits including improving air quality and public health and increasing access to greater economic opportunities throughout California.

The proposed ICT regulation provides solutions that overcome barriers to access clean transportation for low-income residents and promote environmental justice. The deployment of ZEBs in low-income and disadvantaged communities eliminates tailpipe emissions, reduces particulate matter associated with brake wear, reduces petroleum use, reduces energy consumption and helps California achieve its air quality and climate protection goals. Zero-emission technologies have fuel efficiency two to five times as much as conventional internal combustion engines and are one of the most effective technologies to lead the transportation sector in reducing energy consumption and combustion related emissions. ZEB adoptions in low-income and disadvantaged communities will be an important part of the solution in achieving GHG goals established in many statues or are complementary to existing measures including AB 32, SB 32, SB 350, and SB 375 and in maximizing NOx reductions needed to meet the SIP requirements.

In addition to reducing emissions, the proposed ICT regulation is expected to attract ZEB industries to bring high quality job opportunities to California and to support employment in disadvantaged communities. As the demand and production of ZEBs increases, so would the number of ZEB manufacturing, operation and maintenance related jobs in California. For example, BYD, located in Lancaster, California, has a community benefits agreement (CBA) with Jobs to Move America (JMA), which will support the creation of a robust U.S. jobs program through deep investments in pre-apprenticeship and training programs. This CBA has a goal of recruiting and hiring 40 percent of its workers from populations facing significant barriers to employment, such as veterans and returning citizens. [97] In addition, populations that have historically been excluded from the manufacturing industry, such as women and African Americans are also expected to be recruited and placed. The agreement also includes commitments from BYD to work with the JMA coalition to provide support systems for these workers to strengthen retention efforts, such as providing transportation for workers who may not have access to a car.

Overall, the proposed ICT regulation is consistent with and helps support CARB's environmental justice policies. The ICT regulation echoes the 2016 ZEV Action Plan and supports the governor's Executive Order B-16-12 and Executive Order B-48-12, which calls for 1.5 million and 5 million ZEVs (including heavy-duty vehicles) in California by 2025 and by 2030, respectively, and in addition, establishes several milestones on the pathway toward this target to substantially reduce GHG emissions from ZEVs and have health benefits from reducing criteria pollutant emissions. Reducing GHG emissions will help stabilize the climate, which will benefit all communities, including low-income and disadvantaged communities.

[97] Charged Electric Vehicles Magazine (2017). BYD funds training programs, employs disadvantaged workers at California plant. June 28, 2017. Available: https://chargedevs.com/newswire/byd-funds-training-programs-employs-disadvantaged-workers-at-california-plant/.

VIII. ECONOMIC IMPACTS ASSESSMENT

Sections 11346.3 and 11346.5 of the Government Code require State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment will include consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California businesses to compete. State agencies are also required to estimate the cost or savings to any State or local agency and school districts under instruction adopted by the DOF. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the State.

Government Code section 11346.36(f), requires a state agency to perform a Standardized Regulatory Impact Assessment (SRIA) before adopting any major regulation. Because the estimated cost of the ICT regulation exceeds $50 million in most of years during the timeframe from 2020 through 2050, the ICT regulation constitute a major regulation.

This chapter summarizes results from analyses that estimate the cost benefits impacts of the proposed ICT regulation. The SRIA is attached as Appendix B-1 and available on the DOF website.[98] CARB's responses to comments from the DOF are attached as Appendix B-2.

In the SRIA, the economic impact of the proposed ICT regulation is evaluated against two separate baselines developed in consultation with DOF. The "baseline" reflects hypothetical full compliance with the existing regulation, and the "current conditions" reflects current, real-world conditions, including the Board's direction to delay the purchase requirement and CARB's advisory. In this updated analysis, the economic impact of the proposed ICT regulation is relative to the "current conditions;" the analysis relative to the "baseline" is shown in Appendix I of the ISOR. In the SRIA, the costs and benefits are analyzed through 2043 to reflect full implementation of ZEB purchases, 12-months after 100 percent of buses are projected to be ZEBs. In this updated analysis, the timeframe has been extended to 2050 to include all reporting costs and better account for the emissions benefits and cost savings associated with the required ZEB deployment.

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[98] California Air Resources Board (CARB) (2018). Innovative Clean Transit Regulation. Standardized Regulatory Impact Assessment (SRIA). April 19, 2018. Available: http://www.dof.ca.gov/Forecasting/Economics/Major_Regulations/Major_Regulations_Table/documents/ICT_SRIA_ARB_4-23-18.pdf.

A. Direct Costs

The direct cost inputs of the proposed ICT regulation and current conditions in this analysis include:

- Upfront capital costs for bus purchases, charging or fueling infrastructure, as well as maintenance bay upgrades;
- Annual maintenance costs for bus and infrastructure, as well as bus fuel consumption costs.

The statewide direct costs of the proposed ICT regulation to deploy ZEBs are determined by cost input assumptions for each bus, such as bus capital cost ($/bus) and maintenance cost ($/mile), as well as projected bus population by different powertrains.

Compared to conventional internal combustion engine buses, ZEBs generally have higher upfront capital cost, but lower operational cost that result in annual savings. The cost analysis does not include any grants or rebates and shows the total costs attributable to the regulation without grants. The actual cost to transit agencies will be lower than these estimates if they act early to take advantage of existing funding programs. More details on cost related calculations and assumptions can be found in the SRIA or Appendix B.

1. Changes Since the Release of SRIA

The proposed ICT regulation as well as main analysis assumptions have been updated since release of the Standard Regulatory Impact Assessment (SRIA) on April 19, 2018. Some changes are being proposed as a result of stakeholder input since then. These changes and their potential impacts on the economic analysis are summarized as follows:

- *ZEB phase-in schedule.* With comments and feedback from stakeholders, CARB staff is proposing additional time to implement the ZEB purchase requirements to provide flexibility to transit agencies. This change means a three-year push back on the starting date for ZEB purchase requirement and would begin in 2023 for large transit agencies and in 2026 for small transit agencies.

  In the SRIA, all bus types are phased in using the same purchase schedule. In the current staff proposal, cutaway, articulated, and over-the-road buses will not be required for purchase until 2026 or when technologies are commercially available, whichever is later. This proposal will change the corresponding costs and emission reduction benefits in early years. The statewide cost saving will be observed in the same way because the 100 percent purchase requirement is still

in the same year (2029) as previously proposed. The cumulative emission reductions will be the same because the vehicle numbers are the same. However, the annual emission reductions before 2029 will be distributed differently; i.e. emission reductions will begin in 2023 instead of 2020.

- *Waiver of ZEB purchases*. A new voluntary option is introduced to allow for up to a two-year waiver of initial purchase requirements in 2023 and 2024 if at least 1,000 ZEBs are purchased by the end of 2020 and 1,150 ZEBs are purchased by the end of 2021. This option provides transit agencies great flexibility to access available funding and plan for their own ZEB deployment without a regulatory constraint. All ZEBs purchased to meet the waiver targets can be used to meet the purchase obligation starting 2025. This waiver option will not decrease the total number ZEBs to be bought under the proposed ICT regulation. If the waiver is triggered, ZEB purchases will occur much earlier than otherwise required which is expected to result in substantial early emissions reductions. The potential impacts of the waiver option are discussed in more detail below.

- *Impacts of bonus credits.* Statewide, transit agencies are expected to receive 132 bonus credits, which can be used to postpone the purchase of 132 ZEBs. This effect is modeled for both emission reductions and cost analysis. The bonus credits would likely result in fewer ZEBs in early years reducing both the costs and emission benefits as analyzed below. Bonus credits are issued to reward early adopters that took a risk to demonstrate new zero-emission technologies and provide implementation flexibility. The intrinsic value of the demonstration of technology viability is far higher than the face value of these bonus credits.

- *Base and growth of vehicle population.* In this updated analysis, the inventory of buses has been updated to more accurately reflect bus GVWR. In addition, a static bus population was assumed in the SRIA analysis. The statewide growth rates of urban buses from EMFAC2017 (0.7 to 1.4 percent per year) are used in this updated analysis to project future bus populations. EMFAC2017 assumes the increase of bus numbers is a result of population growth and MPOs' strategies. This growth would increase the number of buses each year and increase the infrastructure needed in the economic analysis. EMFAC2017 (including bus population growth) was already used in the SRIA to determine emissions and health impacts. As such, this change has no impact on emissions.

- *Separation of cutaway buses and other buses*. In the SRIA, all buses were treated as standard buses with the same lifetime and the same cost information. With comments from stakeholders, cutaway buses have been separated as a

group and assigned shorter lifetimes and lower bus prices in this updated analysis. Cutaway buses are less costly and are typically operated for 10 years instead of 14 years. The cost analysis now considers both the accurate upfront cost, and the lifetime of buses in this category. The separation of cutaway buses from standard buses decreases overall costs. This separation in the cost analysis will not change emission or health benefits as cutaway buses were already considered separately in the emission inventory.

- *Cost input* assumptions. A number of adjustments were made to more accurately reflect costs:

  (1) *Timing gap between bus purchases and delivery*. It usually takes approximately one year for transit agencies to get vehicles delivered after their purchases. The payment for vehicle capital cost, fuel consumption and maintenance, as well as emission reductions occur when vehicles are in service. A one-year delay between vehicle purchase and delivery was added to more accurately reflect expenditures and emissions.

  (2) *Prices for oil and natural gas.* Prices for diesel, gasoline and CNG were updated with the latest information from the Energy Information Administration (EIA)'s Annual Energy Outlook 2018 (AEO2018). In the SRIA, information from AEO2017 was used.

  (3) *Electricity costs*. Based on comments from transit agencies, the charger size was increased from 60 kW used in the SRIA to 80 kW to better match expected charging times for longer range buses. This results in a minor increase in electricity costs. As explained in Appendix D for Total Fuel Cost in ISOR, the growth rate of electricity costs for the commercial sector was used instead of the electricity costs for the transportation sector.

  (4) *Energy use for BEBs.* Energy use for BEBs were changed from 2.1 kWh/mile in the SRIA to 2.3 kWh/mile to better consider energy loss during charging. This change will increase total electricity use by BEBs, and it will increase total electricity cost and LCFS credits earned.

  (5) *LCFS credits.* LCFS assumptions have been updated to be consistent with that rulemaking's ISOR[99] released along with the Board hearing on April 27, 2018.

[99] California Air Resources Board (CARB) (2018). Public Hearing to Consider Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels. March 6, 2018. Available: https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf.

(6) *Other associated costs for ZEB deployment.* Deployment of a new technology requires operational adjustments including but not limited to operator and technician training, purchase and update of software, and the need for additional spare parts. In the SRIA, these costs were not considered but have been accounted for here resulting in an increase in the total cost.

(7) *Rollout Plan costs.* To effectively and efficiently deploy ZEBs, a transit agency must perform some upfront planning and site assessment upfront. To ensure this planning effort is carried out in a thoughtful way, a Rollout Plan requirement has been added since the SRIA. This cost is actually part of the "other associated cost for ZEB deployment" but discussed separately to provide more clarity. The cost associated with developing the Rollout Plan and associated planning for a zero-emission fleet has been added and will increase the total costs.

(8) *Reporting costs.* The reporting cost was not included in the SRIA. In this updated analysis that reflects the current staff proposal, costs associated with reporting requirements are added and result in a small increase in total costs.

2. Cost Inputs

a. Upfront Capital Costs

Bus Capital Costs

Bus capital cost represents a large share of total costs. Staff estimated standard bus capital cost for different powertrains in 2016 based on direct communications with bus manufacturers and bus purchase contracts at that time for 40-foot standard buses (Appendix F-1).[100] At that time, the incremental cost for a 40-foot depot-charging BEB (with a battery size of 324 kWh) was around $335,000 over that of a diesel bus and was around $285,000 over that of a CNG bus.[101]

As shown in Appendix F-2, the projection of conventional internal combustion engine bus prices in the future is based on historical trends in the American Public Transportation Association (APTA) database. Additional cost reductions of bus batteries are considered to project BEB prices in the future. It is widely acknowledged that large orders and economies of scale will result in reduced bus prices. There are limited data to conduct a BEB price projection reflecting economies of scale. The staff

[100] California Air Resources Board (CARB) (2017). Bus Price Analysis Discussion Draft. February 10, 2017. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626buspricesanalysis.pdf.

[101] Staff estimated that the incremental cost of a CNG bus over a diesel bus is around $50,000.

analysis is conservative in estimating future BEB prices because the analysis solely reflects lower costs per kWh for batteries and does not reflect any BEB price reductions associated with economies of scale. Based on the battery cost reduction analysis,[102] staff estimated that by 2026 the incremental cost for a BEB with a larger battery (440 kWh) would be less than $205,000 when compared to a diesel bus, and $155,000 when compared to a CNG bus.

It is harder to project the capital costs for a FCEB due to the smaller deployment number.[103] Staff projected that the price of a FCEB could be $900,000 in 2020, based on a purchase volume of 40 buses. New Flyer provided a letter to CARB in May 2014, stating that $900,000 per bus would be feasible with an order of 40 or more buses to be delivered over a 3-year period.[104,105]

Cutaway buses represent a wide variety of vehicle types and lengths.[106] Vehicle prices vary among different vehicle lengths and types. The California Association for Coordinated Transportation (CalACT)/the Morongo Basin Transit Authority (MBTA) Vehicle Purchasing Cooperative (the Cooperative) offers a variety of ADA-compliant vehicles.[107] The purchasing schedule offered by the Cooperative includes class A to class G cutaway buses and minivans from multiple vendors. The median price for a class C gasoline cutaway bus (16 passengers, rear lift) is around $65,000. The length for larger cutaway buses (class E) ranges from 27-ft to 40-foot. The median price for a 27-foot to 29-foot cutaway bus is around $89,000. Staff uses a class C cutaway bus in the cost analysis. The Class C cutaway bus represents a commonly used cutaway type with a lower vehicle cost for the conventional internal combustion engine types, which

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[102] California Air Resources Board (CARB) (2017). Battery Cost for Heavy-Duty Electric Vehicles. August 14, 2017. Available: https://www.arb.ca.gov/msprog/bus/battery_cost.pdf.

[103] National Renewable Energy Laboratory (NREL) (2016). Zero Emission Bay Area (ZEBA) Fuel Cell Bus Demonstration Results: Fifth Report. June 2016. Available: https://www.afdc.energy.gov/uploads/publication/zeba_fcb_rpt5.pdf.

[104] New Flyer Letter to Erik White, May 29, 2014.

[105] California Air Resources Board (CARB) (2015). Draft Technology Assessment: Medium- and Heavy-Duty Fuel Cell Electric Vehicles. November 2015. Available: https://www.arb.ca.gov/msprog/tech/techreport/fc_tech_report.pdf.

[106] Federal Transit Administration (FTA) (2007). An Evaluation of the Market for Small-to-Medium-Sized Cutaway Buses. Final Report. FTA Project Number: MI-26-7280.07.1. December 21, 2007. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/AnEvaluationofMarketforSmalltoMediumSizedCutawayBuses.pdf.

[107] California Association for Coordinated Transportation (CalACT) (2018). CalACT/MBTA 15-03 Purchasing Schedule. Available: https://www.calact.org/assets/Price%20Information%20RFP%2015-03%20Rev%2008302017%20sep17.xlsx.

provides a conservative cost analysis and avoids an underestimated incremental cost. Staff assumes the incremental cost of a CNG cutaway bus over a gasoline cutaway bus is $20,000.[108] Staff has limited information of the price of a battery electric cutaway bus, and assumes the incremental cost with a 100 kWh battery is $100,000 over that of a CNG cutaway bus.[109] The vehicle price projection follows the same method as the 40-foot transit buses. Staff uses a 150 kWh battery pack to represent the average for battery electric cutaway bus price projection because cutaway buses will be purchased after 2026, and it is expected that longer range vehicles will be available at that time.

Infrastructure Capital Costs

Infrastructure cost for ZEB deployment includes costs for hydrogen station or BEB charger (equipment itself) and its installation, electrical service upgrades, maintenance bay upgrades. The major assumptions about infrastructure cost and data sources are available on the ICT website. [110] The infrastructure installation costs are site-specific and can vary greatly. To date, detailed analysis for a conversion of an entire bus depot (with 100 to 200 buses) is not yet available. The average electrical service upgrade and installation cost is estimated to be around $55,000 per depot charger for a large BEB deployment, plus an additional $50,000 for each charger. The analysis did not reflect lower cost estimates for buses which have a built-in charger and use a pedestal that is included with the bus purchase. This analysis also did not reflect higher cost estimates for buses that use overhead charging or high-power charging at a depot yard.

For the infrastructure costs for battery electric cutaway buses, staff includes two types of chargers, and assumes that 50 percent of the cutaway buses would use 19 kW chargers, which are compatible with Level II charging, and 50 percent would use 50 kW chargers. It is estimated that the cost of a 19 kW charger is $2,500, and a 50 kW depot

[108] Staff's estimate is based on the price difference between a gasoline cutaway and a CNG cutaway in the CalACT/MBTA 15-03 Purchasing Schedule, and an estimate provided by the Morongo Basin Transit Authority in January 2018.

[109] Staff's estimate is based on the incremental cost of recent Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) applications, and communication with vehicle manufacturers.

[110] California Air Resources Board (CARB) (2017). Cost Data & Sources. June 26, 2017. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626costdatasources.xlsx.

charger is $25,000.[111] Staff assumes the charger installation cost to be around $25,000 each.[112,113]

The number of ZEBs in the proposed ICT regulation as well as the number of conventional internal combustion buses in current conditions will increase over time as a result of human population growth and MPOs' strategies. The vehicle number growth will then have an effect on the associated cost for both the proposed ICT regulation and current conditions. The growth impact on cost is modeled and included for ZEB infrastructure with the proposed ICT regulation because all infrastructure will be new. However, it is difficult to model for the infrastructure for buses with internal combustion engines with limited or no information. First, it is uncertain which transit agencies will need to have a major infrastructure expansion, like adding a new facility, to accommodate such growth. Second, insufficient information is available to determine whether existing fueling infrastructure and space will need to be upgraded or expanded to accommodate the growth. Therefore, the increase of fueling infrastructure for buses with internal combustion engines is not included in the current conditions, which will result in a lower total cost. If total costs in the current conditions are lower estimates, then incremental costs in the proposed ICT regulation relative to current conditions would be a higher estimate. This assumption results in a conservative assumption for total costs in the proposed ICT regulation. The number of chargers, hydrogen stations, and upgraded maintenance bays are based on the projected number of ZEBs and throughput of each infrastructure type. It is also assumed that once the infrastructure is in place, it can be used for other vehicles even after the original vehicles are retired.

b. Operational and Maintenance Costs

Bus Midlife Costs

It is assumed each bus will require one midlife overhaul for engine rebuild, battery replacement, or fuel cell system replacement. This is assumed to occur at seven years for a standard bus or at five years for a cutaway bus. The costs for the midlife overhaul do not include maintenance costs for repairing or replacing seats, windows and other items that are common to all buses regardless of drivetrain, and thus would already be

[111] Phoenix Motorcars (2017). Email communication with Tarek Helou, Director of Sales, on November 30, 2017.

[112] Installation cost varies depending on sites. Staff's estimate is based on the data provided by Phoenix Motorcars by email on November 28, 2017 from an off-airport parking company electrification project.

[113] Phoenix Motorcars (2017). Email communication with Tarek Helou, Director of Sales, on November 28, 2017.

included in the baseline. Table VIII-1 summarizes the cost of bus midlife overhaul for different powertrains.

Table VIII-1: Cost of Standard Bus and Cutaway Bus Midlife Overhaul by Technology

Technology	Standard Bus (at 7-year)	Cutaway Bus (at 5-year)
CNG	$35,000	$21,000
Gasoline		$6,000
Diesel	$35,000	
Diesel hybrid	$35,000	
Low-NOx CNG	$38,000	
BEB[a]	$75,000 (330 kWh)	~$20,000-$35,000 (150 kWh)[b]
FCEB	$200,000	

[a] Midlife battery replacement varies with battery size

[b] Assuming one battery replacement at the middle of cutaway bus's lifetime, and the cost for midlife varies with battery costs.

Cutaway buses have an FTA required minimum lifetime of 7 years and 200,000 miles and transit agencies usually operate them for 10 years. Based on information provided by Phoenix Motorcars, the engine replacement frequency for a gasoline cutaway bus is every 150,000 miles, and every 75,000 miles for a CNG cutaway bus. The engine replacement cost for a gasoline cutaway bus and a CNG cutaway bus is around $6,000 and $7,000 respectively.[114] For modeling midlife costs, a single midlife cost is used reflecting an average of $6,000 for gasoline and $21,000 for CNG. For battery electric cutaway buses, the midlife cost would be the cost for one battery replacement at the middle of the lifetime.

Bus Maintenance Costs

Bus maintenance costs are dependent on several factors including vehicle age, drive and duty cycles, road conditions, topography, and regular fleet maintenance practices. Ideally, comparisons of different technologies are most relevant if made on the same routes, similar average speeds, and in the same fleet. Staff used the Transit Agency Subcommittee (TAS) Cost Subgroup's recommendations[115] on the maintenance costs for conventional internal combustion engine buses, which are based on the data of the CNG fleet from the LA Metro. The average maintenance cost for a CNG bus is around

[114] Phoenix Motorcars (2017). Email Communication with Tarek Helou, Director of Sales, on November 1, 2017.

[115] Transit Agency Subcommittee-Lifecycle Cost Modeling Subgroup (2017). Report of Findings, April 2017.

$0.85/mile. Based on transit agencies experience, the maintenance cost for a diesel bus is slightly lower than that of a CNG bus and is assumed to be $0.79/mile.

CARB staff conducted a literature review of available empirical data to answer questions about what maintenance costs per mile should be used for BEBs and FCEBs when they are compared with typical conventional internal combustion engine buses. This literature review was released to the public during a workgroup meeting[116] and is also provided as Appendix G of this ISOR. Based on staff's literature review, it is expected that the maintenance costs of a BEB propulsion system and related components are lower than that of a diesel or a CNG bus because electric buses have fewer moving parts and fewer regular maintenance needs (such as oil changes and brake relines) than diesel and CNG buses. Currently, data on long-term maintenance costs of ZEBs are limited. Staff estimates BEB maintenance costs to be on average about $0.19/mile lower than diesel and $0.25/mile lower than CNG for an average bus. The savings reflects about $0.08/mile maintenance savings from avoided regular maintenance like oil changes, valve adjustments, and filter changes and about $0.11/mile primarily associated with reduced brake wear. We also recognize that maintenance costs are typically lower when buses are new and on average increase as buses age; however, in modeling total cost of ownership we use the average in all years consistent with the methodology discussed with Cost Subgroup. CARB has been funding studies to collect the operation and maintenance data of ZEBs for our further understanding.

For gasoline cutaway bus maintenance costs, staff uses $0.26/mile, which is estimated by Access Services in Los Angeles County.[117] Staff assumes the maintenance cost for a CNG cutaway bus is similar to a gasoline cutaway bus.[118,119] For a battery electric cutaway bus, staff assumes a maintenance cost of $0.20/mile. This is calculated based on the same percentage of maintenance saving of a BEB over a diesel bus. Staff estimates the maintenance cost of a BEB is about 76 percent of a diesel bus (Appendix

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[116] California Air Resources Board (CARB) (2016). Literature Review on Transit Bus Maintenance Cost. August, 2016. Available: https://www.arb.ca.gov/msprog/bus/maintenance_cost.pdf.

[117] Access Services. Access Services Projected Fleet Costs for the Service Fleet in Los Angeles Paratransit Services. Available: https://www.sacog.org/sites/main/files/file-attachments/access_la_life_cycle.pdf.

[118] Based on the information provided to staff by Phoenix Motorcars in November 2017, the maintenance cost for a gasoline cutaway bus is the same as CNG cutaway bus (exclude engine replacement).

[119] Phoenix Motorcars (2017). Email communication with Tarek Helou, Director of Sales, on November 1, 2017.

G).[120,121] Maintenance cost for standard buses and cutaway buses are summarized in Table VIII-2.

Table VIII-2: Maintenance Cost for Standard Buses and Cutaway Buses (2016 $/mile)

Technology	Standard Bus	Cutaway Bus
CNG	$0.85/mile	$0.26/mile
Gasoline		$0.26/mile
Diesel	$0.79/mile	
Diesel hybrid	$0.68/mile	
Low-NOx CNG	$0.85/mile	
BEB	$0.60/mile	$0.20/mile
FCEB	$1.00/mile	

Infrastructure Maintenance Costs

Depot and on-route chargers for ZEBs need to be maintained regularly. The maintenance cost of depot chargers are estimated by considering costs for replacing charger heads, connectors, and other components, as well as labor costs for regular inspections.[122,123] The information about on-route chargers is based on data from Foothill Transit, which has experience with Proterra on-route chargers.[124] Charger maintenance costs are summarized in Table VIII-3. CARB Staff assume that the maintenance cost for other fueling infrastructures, including diesel, CNG, and hydrogen, are reflected in the fuel price. For these fuels, in addition to the maintenance cost of the fueling infrastructure, the fuel price also includes distribution and utility cost for gas compression.

[120] Diesel bus maintenance cost is estimated to be around $0.8/mile. Staff estimates that there is a $0.19/mile maintenance cost saving for a BEB over a diesel bus due to $0.11/mile regenerative brake cost savings and $0.08/mile for propulsion related saving. The maintenance cost of a battery electric cutaway bus is $0.26*(1-$0.19/$0.80) = $0.20/mile.

[121] California Air Resources Board (CARB) (2016). Literature Review on Transit Bus Maintenance Cost. August 2016. Available: https://www.arb.ca.gov/msprog/bus/maintenance_cost.pdf.

[122] Tesla (2016). Phone Communication with Beau Whiteman, Senior Technical Program Manager, on October 28, 2016.

[123] Clipper Creek (2016). Phone Communication with Will Barrett, Director of Sales, on October 28, 2016.

[124] Foothill Transit (2017). Email communication with Andrew Papson, Electric Bus Program Manager, in March 2017.

Table VIII-3: Estimated Charger Maintenance Costs

Technology Type	Maintenance Cost	Buses/Unit
Depot Charger	$500/charger each year	Each bus has its own charger
On-Route Charger	~$13,000/charger each year and ($0.03/kWh)	6 buses share one charger

Fuel costs

Both fuel consumption (a result of vehicle fuel efficiency) and fuel price affect the fuel cost. Vehicles with different fuel types and technologies have different fuel efficiencies. Fuel efficiency is affected by several factors, such as drive cycle, weather, terrain, payload, driving pattern, etc.

For standard buses, staff used the average fuel efficiency provided by several large transit agencies for their fleets in the cost analysis.[125] The energy use for a BEB is based on empirical data from Foothill Transit,[126] with an overall average energy use of 2.15 kWh/mile, or 0.47 mile/kWh. While this represents the energy use from the vehicle, considering an average energy loss of about 10% during charging,[127] the energy use from grid would be 2.3 kWh/mile, which is consistent with "grid-side" energy use for BEBs evaluated at King County Metro.[128]

For a class C gasoline cutaway bus, Access Services in Los Angeles County estimates the fuel efficiency to be around 6 miles/gallon.[129] The reported overall fuel efficiency from an Altoona bus testing report for a 32-foot CNG cutaway bus is 1.26 miles/lb, or

[125] California Air Resources Board (CARB) (2017). Cost Data & Sources. June 26, 2017. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626costdatasources.xlsx.

[126] National Renewable Energy Laboratory (NREL) (2016). Foothill Transit Agency Electric Bus Demonstration Results. January 2016. Available: https://www.nrel.gov/docs/fy16osti/65274.pdf.

[127] National Renewable Energy Laboratory (NREL) (2017). Foothill Transit Battery Electric Bus Demonstration Results: Second Report. June 2017. Available: https://www.nrel.gov/docs/fy17osti/67698.pdf.

[128] Federal Transit Administration (FTA) (2018). Zero-Emission Bus Evaluation Results; King County Metro Battery Electric Buses. February 2018. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/115086/zero-emission-bus-evaluation-results-king-county-metro-battery-electric-buses-fta-report-no-0118.pdf.

[129] Access Services. Access Services Projected Fleet Costs for the Service Fleet in Los Angeles Paratransit Services. Available: https://www.sacog.org/sites/main/files/file-attachments/access_la_life_cycle.pdf

50.58 miles/MMBtu, which is about 6.4 miles/DGE (or 5.8 miles/GGE).[130,131] For the cost analysis, staff use a fuel efficiency of 6 miles/gallon for both gasoline and CNG cutaway buses. For a battery electric cutaway bus, based on the data from 16 electric shuttle buses[132] operating between a parking facility and the airport terminals at the Los Angeles International Airport, the average overall vehicle energy consumption is $1.23 kWh/mile, which includes all energy consumed during driving, idling and operation of utilities (e.g., HVAC unit).[133] The energy consumption from the electrical grid is about 1.45 kWh/mile with the charging efficiency incorporated. Table VIII-4 summarizes the average fuel efficiency used for this analysis.

Table VIII-4: Average Fuel Efficiency of Buses by Technology

Technology	Standard Bus	Cutaway Bus	Unit
CNG	2.91	6.0	mile/dge
Gasoline	NA	6.0	mile/dge
Diesel	3.87	NA	mile/dge
Hybrid Diesel	4.84	NA	mile/dge
BEB*	2.3	1.45	kWh/mile
FCEB	6.30	NA	mile/kg

* Energy use from grid, with the consideration of energy loss from charging.

CNG, gasoline, and diesel fuel prices are based on EIA's AEO2018, as shown in Figure VIII-1. The EIA commercial natural gas prices are in line with the total pump price paid by California transit agencies per responses to 2016 CARB transit agency survey. The total pump price for CNG includes the commodity, transmission, compression, and station maintenance costs.

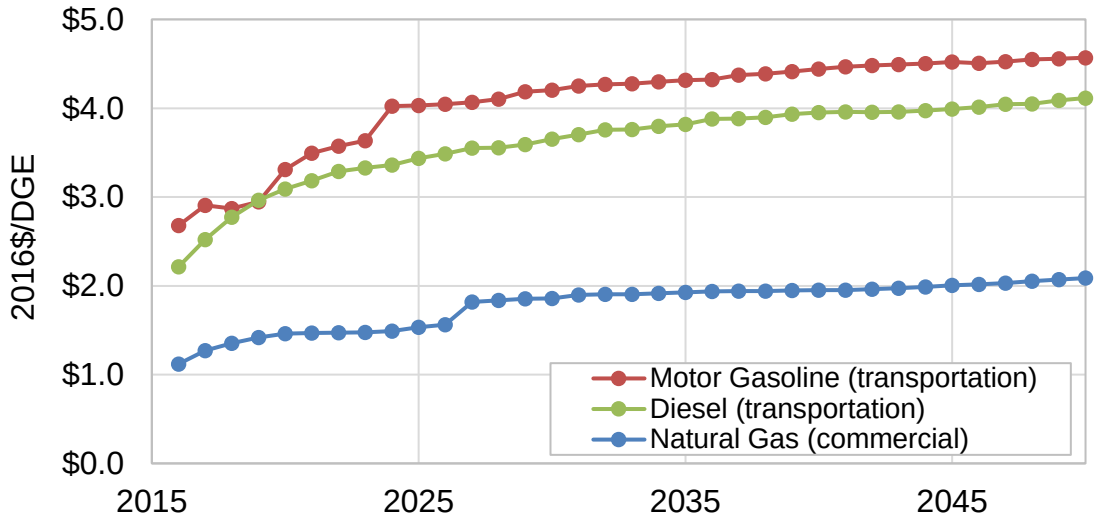
[130] Bus Testing and Research Center (2011). STURAA Test, 7 Year, 200,000 Mile Bus from Supreme Corp/Startrans Bus - Model Senator HD Cutaway. April 2011. Available: http://altoonabustest.psu.edu/buses/reports/379.pdf?1329832711.

[131] Staff converted the value to miles/DGE, and miles/GGE.

[132] The electric shuttle buses are Class 3 cutaway buses. The energy consumption for a class 3 and class 4 is similar based on staff's communication with Phoenix Motorcars in 2017.

[133] Phoenix Motorcars (2017). Case Study: Wally Park Premier – Zero-Emission Utility Shuttles Fleet. July 28, 2017.

Figure VIII-1: Gasoline, Diesel, and Natural Gas Fuel Price from EIA 2018



Electricity cost per kWh varies by electric utility service areas and charging strategies. Staff has used the CARB electricity cost calculator to estimate the electricity cost.[134] For this analysis, it is assumed that most transit agencies will utilize managed charging at the depot, where total energy demand is managed by the use of charging management software or timers; this strategy will enable transit agencies to charge buses in sequence and reduce total electricity demand and costs. An individual transit agency may experience higher unit electricity costs when charging a small number of buses at a depot, and will have lower unit electricity costs when charging more buses at the same depot if the transit agency is able to sequence charging to avoid increasing overall facility demand. This analysis uses a simplified assumption for electricity costs based on charging for a fleet with 100 BEBs in one depot, for the case of charging standard BEBs (Table VIII-5), or 40 battery electric cutaway buses in one depot (Table VIII-6) (details shown in Appendix I). For on-route charging, the electricity costs are based on having an average of six buses for each charger (Table VIII-5). Staff used the annual growth rate of electricity price for the commercial sector from EIA to project changes in the future electricity cost.

[134] California Air Resources Board (CARB) (2017). Draft Battery Electric Truck and Bus Charging Calculator. June 26, 2017. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626chargecostcalcv3.xlsm.

Table VIII-5: Electricity Costs for Standard Buses in 2016 with Managed Depot Charging (2016$)

Utility	Managed Depot Charging ($/kWh)[a]	On-Route Charging ($/kWh)[b]
PG&E	$0.18	$0.25
SCE	$0.10	$0.20
LADWP	$0.10	$0.16
SDG&E	$0.21	$0.31

[a] Represents a scenario where charging in the depot reduces maximum demand by 50 percent through decreased charge power, sequential bus charging, or other means. Vehicles charged at 80 kW. Assumptions used: 100-bus fleet; 130 miles/day; vehicle energy use 2.1 kWh/mile; 90 percent charging efficiency; "Evening" (7p-6a) charging.

[b] Represents on-route charging up to 10/15 min (500 kW charger); 6 buses/charger; 130 miles/day; 2.1 kWh/mile; 90 percent charging efficiency; "Day Time" (6a-10p) charging

Table VIII-6: Electricity Costs for Cutaway Buses in 2016 with Managed Depot Charging (2016$)

Utility Name	Managed Depot (19 kW) ($/kWh)[a]	Managed Depot (50 kW) ($/kWh)[b]	Weighted Average ($/kWh)[c]
PG&E	$0.18	$0.21	$0.20
SCE	$0.11	$0.11	$0.11
LADWP	$0.10	$0.11	$0.11
SDG&E	$0.21	$0.25	$0.23
SMUD	$0.12	$0.12	$0.12

[a] Assumptions used in the calculator: vehicles charged with 19 kW charger; 40 vehicles at a meter location; 100 miles/day/vehicle; vehicle energy use 1.23 kWh/mile; charging efficiency is 85 percent.

[b] Assumptions used in the calculator: vehicles charged with 50 kW charger; 40 vehicles at a meter location; 200 miles/day/vehicle; vehicle energy use 1.23 kWh/mile; charging efficiency is 85 percent.

[c] with 50 percent 19 kW charger and 50 percent 50 kWh charger

Hydrogen prices are highly dependent on station throughputs and are expected to decrease when more FCEBs are in use. This analysis uses $8.00/kg as the 2016 hydrogen price[135] and assumes the future hydrogen price will decrease to $4.00/kg in 2020.[136]

[135] National Renewable Energy Laboratory (NREL) (2015). American Fuel Cell Bus Project Evaluation: Second Report. September 2015. Available: http://www.nrel.gov/docs/fy15osti/64344.pdf

[136] U.S. Department of Energy (U.S. DOE) (2016). Hydrogen and Fuel Cells Program, 2016 Annual Merit Review and Peer Evaluation Meeting, page 11: DOE Cost Targets and Status. June 6, 2016. Available: https://www.hydrogen.energy.gov/pdfs/review16/02_satyapal_plenary_2016_amr.pdf.

LCFS Credits

The LCFS program is a regulation designed to reduce carbon intensity associated with the lifecycle of transportation fuels used in California. LCFS is a well-established program and transit agencies have been benefiting from this program by operating ZEBs or fixed guideway systems,[137] dispensing fossil CNG, or using hydrogen in fuel cell buses. The credits can be sold to regulated parties in LCFS to generate a revenue stream, or used to offset ZEB deployment costs for transit fleets. The LCFS regulation is currently in the process of rule amendment. The LCFS staff proposal includes three major components that would affect transit agencies: (1) increasing the BEB energy efficiency ratio by about 20 percent for transit buses; (2) further reducing the carbon intensity for the transportation fuels through 2030; and (3) clarification on how hydrogen station operators can receive credits.

CARB staff has provided a summary for how transit agencies can earn credits under the LCFS (Appendix H).[138] The LCFS regulation is currently in the process of being amended. While the LCFS regulation is being amended with updated carbon intensity benchmarks and carbon intensity values for fuels,[139] the method to calculate LCFS credits is the same. In the case of operating a BEB, a transit agency would generate a revenue of about $0.11/kWh in 2018 for the electricity used if the LCFS credit price is at $100 per $MTCO_2e$. The June 2018 LCFS credit price ranged from $100 to $185 per $MTCO_2e$. [140] This LCFS revenue can offset the electricity cost partially for charging BEBs, especially for depot charging.

Other Associated Cost for ZEB Deployment

In addition to direct capital costs and operational and maintenance costs on buses and supporting infrastructure, a transition to a new technology often has costs associated with it; these include costs related to deployment of the technology and of changing

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[137] Fixed Guideway System means a system of public transit electric vehicles that can operate only on its own guideway (directly operated, or DO) constructed specifically for that purpose, such as light rail, heavy rail, cable car, street car, and trolley bus.

[138] California Air Resource Board (CARB) (2016). How Earned Low Carbon Fuel Standard (LCFS) Credits Change from Year to Year. August 17, 2016. Available: https://www.arb.ca.gov/msprog/bus/lcfs.pdf.

[139] California Air Resources Board (CARB) (2018). Proposed Amendments to the Low Carbon Fuel Standard Regulation and Regulation on Commercialization of Alternative Diesel Fuels. Staff Report: Initial Statement of Reasons. March 6, 2018. Available: https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf.

[140] California Air Resource Board (CARB) (2018). Weekly LCFS Credit Transfer Activity Reports. Last Reviewed July 17, 2018. Available: https://www.arb.ca.gov/fuels/lcfs/credit/lrtweeklycreditreports.htm.

operating and maintenance practices. Associated costs, such as operator and technician trainings, purchase and upgrade of software, and possible spare parts, are reoccurring.

Planning costs are upfront and need to be spent even before bus procurement or infrastructure construction. The proposed ICT regulation requires a Rollout Plan from each transit agency and its associated cost is discussed in the section for Rollout Plan cost.

However, limited information is publicly available for this type of transitional cost. After discussing these topics with stakeholders, no consensus on an appropriate estimate has been achieved. During the public discussion of the workgroup meeting in June 2017, CARB staff assumed that the other costs associated with ZEB deployment were equivalent to 2.5 percent of bus prices for all powertrains. It was also discussed that the cost of ZEBs should go down over time as they become more common.[141] This method is based on the assumptions that the Cost Subgroup used to reflect estimated soft costs for conventional internal combustion engine buses.[142]

In the SRIA, these other associated costs for ZEB deployment were not included. In this updated cost analysis, these transitional costs are estimated to be 2.5 percent of bus prices reflecting a higher cost for ZEBs when compared to conventional internal combustion engine buses and assumed to be equal to conventional internal combustion engine buses by 2029 when all bus purchases must be ZEBs. The decline in costs reflects that with longer range buses expected in the future, bus operation and dispatch would be similar to conventional internal combustion engine buses, and transit agencies will not need to prepare bids for different technology buses. In addition, technician training for advanced technologies is already available and is expected to become commonplace at colleges. Technicians will be able to specialize on ZEB drivetrain repair after a significant number of ZEBs are deployed at a location.

The cost for battery recycling at the end of battery life is not included here, because this cost could potentially be offset by the residual value of the battery at the end of bus life. The energy capacity of the batteries used in ZEBs will naturally degrade over time and will need replacement. When battery capacity is not sufficient for meeting daily range needs for a bus, it is expected that there will be a second life for the batteries. For

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[141] California Air Resources Board (CARB) (2017). Presentation for 5th Innovative Clean Transit Workgroup Meeting. August 14, 2017. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626_wg_pres.pdf.

[142] Transit Agency Subcommittee-Lifecycle Cost Modeling Subgroup (2017). Report of Findings, April 2017.

example, batteries can be repurposed for different usage, such as stationary energy storage. This could become a new revenue source for the transit agencies and could be used to offset the disposal cost of batteries. Staff does not have enough data regarding the residual value of the batteries after they are retired from buses because battery electric buses have not yet reached the end of life stage. However, some lithium-ion battery manufacturers do provide an attractive residual value to customers upon the retirement of a battery.[143] Therefore, staff believes that the residual value can offset the recycling cost and does not include a residual battery value in the economic analysis for the transit agencies.

c. Rollout Plan Costs

The cost associated with developing the Rollout Plan and associated planning for a zero-emission fleet is added and will increase the total cost of the ICT proposal. With comments and feedback from stakeholders, CARB staff is proposing to require a Zero-Emission Bus Rollout Plan (Rollout Plan) for large transit agencies in 2020 and for small transit agencies in 2023. The Rollout Plan would need to describe how a transit agency is planning to achieve a full transition to zero-emission technologies and would need to be approved by the transit agency board.

Similar to other costs, there is limited information publicly available for this kind of Rollout Plan cost, and most agencies are still in the early stages of consideration and planning. The estimated cost includes professional services for planning, designing and managing ZEB deployment, and staff time to prepare a recommendation to the Board. Consulting services for this kind of planning in the Rollout Plan could cost around tens to hundreds of thousands of dollars depending on the size of fleets. For example, North County Transit District intends to spend around $1 million on as-needed specialized consulting services to support planning, evaluation, and procurement of ZEB technology.[144] North County Transit District has two depots with more than 200 buses.

For this analysis, CARB staff assumes that the total cost of the Rollout Plan would average about $500,000 per depot (approximately 200 buses). The average cost is approximately $2,500 per bus. This amount is expected to vary widely among transit agencies. Some transit agencies already have plans to deploy ZEBs. Some may choose to hire consultants to evaluate a wide range of options for their fleet, and others may be able to take advantage of other transit agencies' experience. The average cost

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[143] EnerDel applies a 25% of residual value to retired batteries http://enerdel.com/services/guaranteed-residual-value/. Accessed July 10, 2018.

[144] North County Transit District (2017). Board Meeting, Agenda Item #17. September 21, 2017. Available: https://lfportal.nctd.org/weblink/ElectronicFile.aspx?docid=83560&dbid=0.

is allocated based on the bus fleet size reflecting lower costs for small fleets compared to larger ones. Further, it is also assumed that this cost is upfront and occurs in the year that transit agencies are required to submit the Rollout Plan, which is 2020 for large transit agencies and 2023 for small transit agencies.

d. Reporting Costs

The proposed ICT regulation requires all transit agencies to report their fleet information annually, starting in 2021. For the initial report, transit agencies will need to report information on all active buses in the fleet as of December 31, 2017, within the scope of the regulation to determine fleet size.

In subsequent years, transit agencies would not have to re-input vehicle information already on file in the database. Transit agencies instead would only need to add vehicle information for those newly purchased or delete vehicles that are no longer part of the fleet. In addition, transit agencies would also submit fuel contracts if renewed, and information for any mobility programs if applied.

Staff estimates that the proposed reporting requirements would require a larger time commitment in the first year than in subsequent years. The following assumptions are used in estimating needed time and associated costs for reporting:

(1) The hourly rate for a clerical employee to input data to meet the ICT reporting requirements is assumed to be $50 per hour. [145]
(2) Time spent on reporting would decrease by 50 percent in subsequent years.
(3) Transit agencies would need 20 minutes per vehicle in the first year and 10 minutes per vehicle in subsequent years.

The total reporting costs are estimated to be about $225,000 in the first year and about $135,000 each year, thereafter until 2050.

3. Bus Population

In this updated analysis, the bus population is based on NTD 2016[146] and it is grouped as cutaway buses and other buses, which include standard, articulated, and over-the-road buses. Because of a lack of detailed information of GVWR and fuel types

[145] California Air Resources Board (CARB) (2008). Technical Support Document: Proposed Regulation for In-Use Road Diesel Vehicles. October 2008. Available: https://www.arb.ca.gov/regact/2008/truckbus08/tsd.pdf.

[146] National Transit Database (NTD) (2016). 2016 Annual Database Revenue Vehicle Inventory. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/Revenue%20Vehicle%20Inventory_0.xlsx.

in rural agencies, assumptions are made based on the bus population with known fuel types, as shown in Appendix I. In this updated analysis, vehicles with the length of 23-feet or less are excluded to more accurately reflect bus numbers under the scope of proposed ICT regulation. Based on the manufacturer and model in NTD, these vehicles are very likely to fall into the category of Class 3 with GVWR less than 14,000 lbs., which is out of scope of the proposed ICT regulation. Note that during the implementation of the proposed ICT regulation, vehicle length will not be used to determine compliance.

In this updated analysis, cutaway buses are separated from other buses to be assigned with shorter lifetime and lower bus prices. The cutaway, articulated and over-the-road buses are proposed to have deferred ZEB purchase requirements until 2026. To analyze the diverse electricity costs, the bus population is further grouped and allocated to different utility areas. Table VIII-7 shows standard bus and cutaway bus allocation to different utility territories according to the assumptions in Appendix I.

Transit agencies statewide have diverse approaches to enhancing transit services, including increasing services by bus, rail, and other mobility programs. The total number of buses may increase over time as a result of human population growth and MPOs' strategies, as assumed in EMFAC2017.[147]

In EMFAC2017, for areas governed by an MPO that forecasts transit growth in target years of the Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), the growth rate is generated by linear interpolation of the growth between the base year and target years; for areas that are not covered by an MPO, or where local MPOs do not provide transit growth, the county-level human population growth rate published by DOF was used as surrogate for transit growth. The statewide growth rates of urban buses, ranging from 0.7 percent to 1.4 percent per year from 2016 to 2050, from EMFAC2017 are used to project future bus population in this analysis. With the growth rates, the total bus number would increase from over 12,000 in 2016 to over 17,000 in 2050.

[147] California Air Resources Board (CARB) (2018). EMFAC2017 Volume III – Technical Documentation. March 1, 2018. Available: https://www.arb.ca.gov/msei/downloads/emfac2017-volume-iii-technical-documentation.pdf.

Table VIII-7: Bus Distributions by Vehicle Type, Agency Size, Utility, and Fuel Type (NTD 2016)

Bus Type	Agency Size	Utility	Diesel	Diesel Hybrid	CNG	Gasoline	Total
Standard Bus& Articulated and Over-the-road Bus	Large	PG&E	2,892	320			3,212
		SCE			2,741		2,741
		LADWP			1,907		1,907
		SDG&E			630		630
	Small	PG&E	1,222	213			1,435
		SCE			1,270		1,270
		LADWP					0
		SDG&E					0
Cutaway Bus	Large	PG&E				169	169
		SCE			50	204	254
		LADWP					0
		SDG&E					0
	Small	PG&E				418	418
		SCE			388	240	628
		LADWP					0
		SDG&E					0
Total			4,114	533	6,986	1,031	12,664

With the growth of bus population, there would be potential expansion of fuel stations for CNG, diesel, and gasoline buses in current conditions. Due to a lack of detailed information of the capacity of current fueling stations, it is challenging to quantify when, where and how many stations to include in the current conditions; for these reasons, this estimate was not included. Without considering the growth impact on fueling stations, the overall cost in the current conditions in likely underestimated. This means that the incremental cost of the proposed ICT regulation could be lower than reported here.

4. Zero-Emission Bus Phase-in Schedule

The ZEB phase-in schedule, or the percentage of ZEBs required in each new purchase, determines the number of ZEBs that enter bus fleets annually. Table VIII-8 shows ZEB phase-in schedules for current conditions, and the updated ICT regulation.

Under current conditions, there are no requirements to purchase ZEBs due to 2010 Board advisory, so that no ZEBs would phase into the fleet. Under this ICT proposal, 25 percent of ZEBs start to be purchased by large transit agencies beginning in 2023 and by small transit agencies beginning in 2026. The requirement of ZEB purchases for cutaway buses, articulated buses and over-the-road buses are deferred until 2026.

In the cost analysis, short-range depot charging buses with 330 kWh or up to 150 nominal miles per charge are purchased from 2020-2025. Mid-range buses with 440 kWh batteries or approximately 200 nominal miles per charge are purchased from 2026-2028, and longer range buses with an average of approximately 550 kWh batteries or 250 nominal miles per charge from 2029 and afterwards. For battery electric cutaway buses, most of the current available models are with a battery size of around 100 kWh, which can provide a nominal range of 100 miles per charge. Staff assumed electric cutaway buses with an average of 150 kWh battery would be purchased after 2026.

This analysis assumes that among the ZEB purchases, 90 percent are depot charging BEBs, 9 percent are on-route charging BEBs, and 1 percent are FCEBs. This split is based on the cost of technology deployment and current purchase trend. It also assumes that all zero-emission cutaway buses would be depot charging battery electric ones.

Table VIII-8: Zero-Emission Bus Phase-In Schedules for Current Conditions, and the Proposed ICT regulation

Year[a]	Current Conditions	Proposed ICT regulation			
	All Agencies	Standard Bus		Cutaway Bus and Other Non-Standard Bus	
		Large Agency	Small Agency	Large Agency	Small Agency
2020	0%	0%	0%	0%	0%
2021	0%	0%	0%	0%	0%
2022	0%	0%	0%	0%	0%
2023	0%	25%	0%	0%	0%
2024	0%	25%	0%	0%	0%
2025	0%	25%	0%	0%	0%
2026	0%	50%	25%	50%	25%
2027	0%	50%	25%	50%	25%
2028	0%	50%	25%	50%	25%
2029	0%	100%	100%	100%	100%

[a] The ZEB phase-in schedules are shown from 2020 to 2029. After 2029, ZEB purchase percentages are the same as the ones in 2029.

5. Bonus Credits

The early bonus credit provision also impacts ZEB populations in the proposed ICT regulation. It is assumed that some transit agencies will obtain early bonus credits resulting in fewer ZEBs in early years. This would impact costs and emissions benefits and the impacts are represented in this updated cost and emission analysis. The

number of bonus credits generated by large and small transit agencies was estimated based on the number of ZEBs in service in individual transit agencies (Table VIII-9).[148] With the consideration of bonus ZEB credits, 95 and 37 fewer ZEBs are required to be purchased by large transit agencies in 2023 and by small transit agencies in 2026, respectively.

Table VIII-9: Bonus ZEB Credits Earned by Large and Small Transit Agencies

Agency Size	ZEB Technology	Bonus Credits
Large	BEB	47
	FCEB	48
	Subtotal	***95***
Small	BEB	17
	FCEB	20
	Subtotal	***37***
Total		132

6. Waiver of Zero-Emission Bus Purchases

To provide further flexibility to the transit agencies and to encourage early emission reductions in local communities, staff is proposing to waive the 2023 and 2024 purchase requirements if a large number of ZEBs are voluntarily purchased early. The waiver would be in effect only if the following criteria are met:

- 2023 purchase requirements would be waived if California transit agencies collectively purchase 1,000 or more ZEBs by December 31, 2020; and
- 2024 purchase requirements would be waived if California transit agencies collectively purchase 1,150 or more ZEBs by December 31, 2021

If transit agencies meet the voluntary waiver target, it is assumed they would do so because it is in their best financial interest. It is likely that transit agencies would make this choice because of the availability of incentives or other funding.

Table VIII-10 illustrates the possible cumulative ZEB purchasing behavior with and without the waiver. This estimate is conservative in that it assumes no ZEB purchases after the waiver conditions are met unless required by the regulations.

[148] California Air Resources Board (CARB) (2018). Battery and Fuel Cell Electric Buses in California. May 2018. Available: https://arb.ca.gov/msprog/ict/faqs/zbusmap.pdf.

Table VIII-10 Illustration of Cumulative ZEB Purchase with and without a Waiver

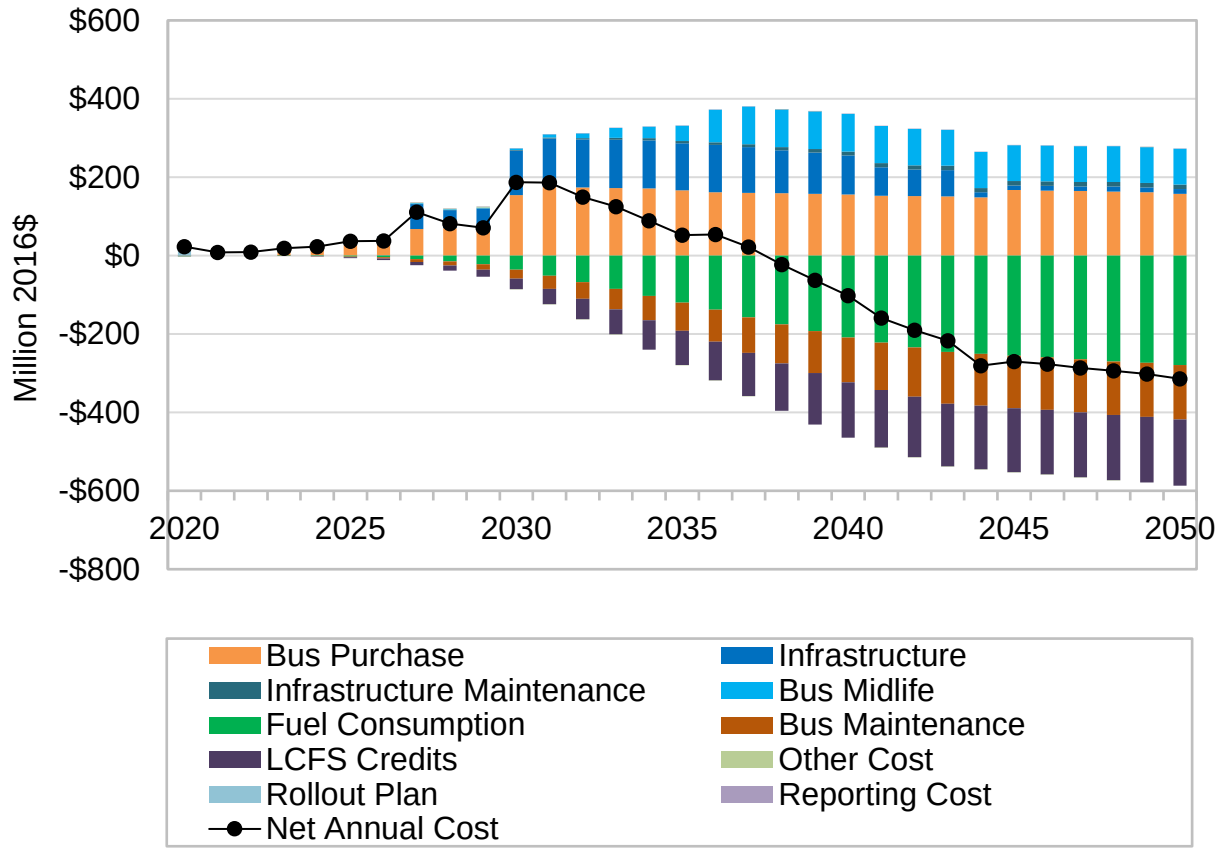
Year	Without Waiver	With Waiver
2020	0	1000
2021	0	1150
2022	0	1150
2023	140	1150
2024	282	1150
2025	426	1150
2026	884	1150
2027	1347	1150
2028	1816	1534
2029	2929	2647
2030	4055	3773

With the waiver, 1,150 ZEBs are purchased at least three years earlier than would otherwise be required by the proposed ICT regulation. This would result in significant early emissions benefits. A majority of large transit agencies in all major regions of California including the South Coast, Bay Area, and Central Valley are indicating they are planning to purchase ZEBs early so it is reasonable to expect overall emissions benefits in all regions if the conditions for the waiver are met. However, the cumulative emission reductions for the proposed ICT regulation are the same with or without the waiver. An early emission reduction means a change of emission reduction distribution in later years.

7. Total Statewide Direct Costs

With the updates of cost inputs, the ICT regulation is expected to result in a total cost saving of $1.5 billion, compared to current conditions, from 2020 through 2050 for transit agencies. As shown in Figure VIII-2, at the beginning of the ICT regulation adoption (2020-2030), the annual costs are positive and increase over time relative to current conditions, mainly because of the gradual phase-in of ZEBs and associated service upgrades and infrastructure installation. After 2038, the annual savings begin to outweigh the higher incremental cost of ZEBs due to savings in ZEB maintenance, fuel costs, credit values from LCFS program, and the buildout of ZEB infrastructure.

Figure VIII-2: Estimated Total Direct Costs of the Proposed ICT Regulation to Transit Agencies Relative to Current Conditions (million 2016$)



B. Direct Costs on Business and Individuals

1. Direct Costs on Typical Business

The proposed ICT regulation primarily affects transit agencies. The initial costs for transit agencies are mainly for the capital costs for ZEBs, electrical service upgrades, and infrastructure. The capital costs for ZEBs are higher than the diesel and CNG buses, but fuel and maintenance cost savings can offset all or most of the initial costs.

The proposed ICT regulation affects engine manufacturers and component supplies, because conventional internal combustion engine buses will be replaced by ZEBs. The total number of buses sold is not expected to change significantly; however, the decreased demand for conventional internal combustion engine buses could result in a decreased demand for internal combustion engines, transmissions and replacement parts.

The proposed ICT regulation would also reduce the operation and maintenance of diesel and CNG fueling stations, as more buses transition to ZEBs.

2. Direct Costs on Small Businesses

There is no expected direct cost on small businesses. They would be effected indirectly to the extent that parts suppliers and fueling station maintenance services are involved.

3. Direct Costs on Individuals

The proposed ICT regulation primarily affects transit agencies and is developed to minimize any direct costs for individuals. The regulation is structured to provide opportunities for transit agencies to take advantage of a substantial incentive funding that is being prioritized to ensure a successful transition to zero-emission technology.

The total cost of the proposed ICT regulation does not incorporate funding nor grants for this analysis to show the costs of the regulatory requirements. However, transit agencies can use grant funding to reduce or eliminate most of the initial incremental capital costs of the proposed ICT regulation. To the extent that transit agencies are successful in offsetting the upfront incremental costs, there would be no increase in fares for individuals riding buses and bus fares could actually be potentially reduced in later years due to operational cost savings. To the extent that some of the incremental costs for an agency are not offset with grants, there could be an increase in fares for some years followed by fare reductions in later years as operational savings increase as the ZEB fleet expands. Transit agencies could also defer some incremental costs with battery lease arrangements that would be paid with operational savings.

C. Benefits

1. Benefits to Transit Agencies

There are several benefits to transit agencies. First, transit agencies may be able to lower fuel costs depending on ZEB purchases and fuel choice. The fuel efficiency of ZEBs is higher than that of conventional internal combustion engine buses (diesel and CNG buses). Fuel cost savings depend on fuel and electricity costs.

Second, the maintenance costs for BEBs are lower than that of conventional internal combustion engine buses. BEBs have simpler mechanical systems and fewer moving parts compared to conventional internal combustion engine buses.

Third, transit agencies that opt into the LCFS program can generate credits through operating ZEBs (transit agencies are first in line to obtain the LCFS credits if they

operate BEBs, or if they generate hydrogen to operate their FCEBs).[149] The credits can be sold to regulated parties in the LCFS program to reduce operating costs for transit fleets.

Fourth, ZEBs would reduce criteria and toxic air pollutants exposure to the transit maintenance staff.

2. Benefits to Other California Businesses

The proposed ICT regulation will benefit several industries. Due to higher demand for ZEBs from the proposed ICT regulation, production of ZEBs in California would likely increase, which leads to increases in manufacturing and related jobs throughout the state.

The increase in the production and usage of ZEBs could also benefit various businesses related to the ZEB component supply chain, including those involved in battery, fuel cell, and electric drivetrain businesses.

The proposed ICT regulation may also benefit electric vehicle supply equipment (EVSE) suppliers, equipment installers, and electricians as a result of increased BEB purchases. The proposed ICT regulation could also benefit various businesses related to installing hydrogen fueling stations, and hydrogen production. All of these will likely be in California.

3. Benefits to Small Businesses

Electricians, construction companies, including infrastructure installers, some bus manufacturers, fuel cell and battery producer, electric drivetrain parts and components suppliers may fall into the small business category. The benefits to ZEB manufacturers and other related business discussed above also apply to small businesses.

4. Benefits to Individuals

The ICT proposal will directly benefit individuals in California. Transit buses operate in local communities. Individuals will directly benefit from reduced adverse health impacts from eliminating emissions in communities. Because ZEBs have zero tailpipe emissions, they achieve the maximum criteria and toxic air pollutant reductions possible. The proposed ICT regulation will result in a reduction in the risk for premature deaths, hospital visits, emergency room visits for asthma, and a variety of other health

[149] Transit agencies can also generate credits for dispensing CNG under the existing LCFS program, but the number of credits they receive are relatively small now and will decline significantly as the required carbon intensity target declines.

effects, especially in sensitive receptors including children, elderly, and people with chronic heart or lung disease. ZEBs also reduce GHG emissions to help mitigate climate change effects. ZEBs offer a more pleasant, smoother and quieter ride to passengers than diesel and CNG buses, and reduce noise levels in communities.

D. Fiscal Impacts

1. Local Government

The proposed ICT regulation directly impacts public transit agencies. Transit services are typically operated by cities, local transportation or transit authorities. The revenues of transit agencies come from different sources, including federal grants, local grants, local taxes, and operating revenues (e.g., fares, advertising sales).

The fiscal impact to local governments and transit agencies varies annually. The annual total direct costs of the proposed ICT regulation to transit agencies from 2020 to 2050 are discussed in Section A of this chapter. As discussed above, Senate Bill 350, chapter 547, statutes of 2015, requires investor-owned utilities to fund infrastructure improvements for transportation electrification, which is expected to offset some of these costs.

Grant funding sources discussed in Section C of Chapter III are expected to help address the incremental costs of the proposed ICT regulation. To the extent they do not, local governments or transit agencies may need to reallocate revenue resources among different municipality services or transportation programs to comply with the proposed ICT regulation. Transit agencies could increase revenue to generate funds or decrease operating expenses by improving transit efficiency (such as service realignments). However, it could be challenging and politically difficult, though possible, to increase revenues by raising taxes or fares. It is expected that the reduced annual O&M expenditures from deploying ZEBs will offset some of the incremental costs of future bus purchases.

2. State Government

The proposed ICT regulation would have a small impact on CARB staffing resources, and would require one additional person-year for developing a reporting system and updating fleet information prior to initial reporting in 2020, assisting transit agencies with compliance and annual reporting, disseminating information to transit fleets, and enforcement (including auditing reported information, -and site visits to confirm vehicle equipment).

The proposed regulation is not expected to have adverse impacts on other state agencies. The implementation of the proposed ICT regulation will help ensure the accountability and enhance the scalability of the implementation of SB 350.

E. Macroeconomic Impacts

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.1.1 is used to estimate the macroeconomic impacts of the proposed amendments on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.

1. Gross State Product (GSP)

GSP is the market value of all goods and services produced in California and is one of the primary indicators used to gauge the health of an economy. Under the proposed ICT regulation, GSP growth is anticipated to decline slightly compared to current conditions as a result of changes in expenditures by transit agencies. GSP grows slightly slower under the proposed ICT regulation than current conditions in all years of the assessment. This analysis indicates the impact of the proposed ICT regulation on GSP is indiscernible in California's estimated $4.9 trillion economy in 2045.

2. California Employment Impacts

Based on the REMI output, the proposed ICT regulation is anticipated to result in a negligible decrease in total employment growth in the early years of the assessment as ZEBs are purchased and infrastructure installed. Employment growth begins to increase in later years as operating and maintenance savings begin to outweigh capital costs; however, the change is indiscernible from employment levels under current conditions.

Industries that manufacture, install, and support ZEB technologies see employment growth at levels higher than current conditions. These industries include ZEB manufacturing, charging infrastructure manufacturing, engineering services, electricity generation, and hydrogen generation. As transit agencies begin the deployment of ZEBs, demand for maintenance and conventional fuels decline, corresponding with the slowing of employment growth that is anticipated in these industries.

3. California Business Impacts

Gross output is used as a proxy for business impacts because it is principally a measure of an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth, as defined in REMI, is the sum of output in each private industry and State and local government as it contributes to the

state's gross domestic product (GDP), and is affected by production cost and demand changes.

Secondary industries that manufacture or support ZEB technologies will see an increase in demand as a result of the proposed ICT regulation. This results in the expansion of output in affected ZEB and component manufacturing, electricity generation, and support activities for transportation. Industries that see less demand as a result of the proposed ICT regulation do see a slight contraction in output growth. Operational savings from the proposed ICT regulation result in less demand for conventional fuels and maintenance, which is reflected in the individual industries' output growth forecast.

IX. EVALUATION OF REGULATORY ALTERNATIVES

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposal. As explained below, no alternative proposed was found to be less burdensome and equally effective in achieving the purposes of the regulation in a manner that ensures full compliance with the authorizing law. The Board has not identified any reasonable alternatives that would lessen any adverse impact on small business.

CARB solicited public input regarding alternatives to achieving the regulatory goals. Two public meetings were specifically devoted to the discussion of regulatory alternatives, including:

- October 4, 2016 at Sacramento: CARB staff held a workgroup meeting[150], to formally solicit alternatives and to discuss a variety of implementation strategies or methods to meet State goals. At the meeting, the following alternative concepts were discussed: purchase requirements, a performance target approach, bus manufacturer sales requirements, and a voluntary based approach.
- October 26, 2016 at Diamond Bar: CARB staff held a TAS meeting[151] to discuss and add details of the performance target alternative proposed by California Transit Association (CTA). At the meeting, CTA solicited help from CARB to develop methods as well as identify metrics and data to quantify a performance-based approach. Based on the interpretation of transit agency discussion, CARB staff evaluated the performance-based approach with several measurement metrics and presented it to transit agencies over two teleconferences in January and February 2017. CTA replaced this initial proposal with a new alternative. On December 15, 2017, CARB staff held a regulatory workshop to release a discussion document on more refined regulatory concepts such as ZEB phase-in schedules. This workshop broadly sought comments on the proposed rule concept and announced the preparation of the environmental analysis.

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[150] California Air Resources Board (CARB) (2016). Alternatives to Advanced Clean Transit. 4th ACT Workgroup Meeting. October 4, 2016. Available: https://www.arb.ca.gov/msprog/bus/4thactwgalternatives.pdf.

[151] California Air Resources Board (CARB) (2016). Transit Agency Subcommittee Meeting. Developing CTA Performance-Based Concept Presentation. October 26, 2016. Available: https://www.arb.ca.gov/msprog/bus/arb_oct_2016_tas_pres.pptx.

The following summarizes alternatives suggested by stakeholders and CARB's rationale for rejecting the proposals as being less effective or feasible than the proposed ICT regulation at reducing emissions and promoting zero-emission heavy-duty vehicles.

A. Alternative Concepts

1. Alternative Concept: Stricter Zero-Emission Bus Purchase Requirement

The concept of this alternative is to have a more aggressive ZEB purchase requirement than the proposed ICT regulation. The end result of reaching 100 percent of new bus purchases remains the same but would occur earlier than planned.

This alternative concept could provide more emission reductions and health benefits from early years; however, it also bears some risks. First, it moves all infrastructure cost earlier which could be too much of a financial burden for transit agencies. Second, a sudden high cost in the early years does not allow transit agencies time to plan for funding sources and could result in adverse impacts like service cuts. Third, it does not allow transit agencies time to adjust for technology learning curve and troubleshooting. Fourth, this alternative does not allow the use of funding sources (shown in Chapter III) that may be available in later years and unnecessarily increases the upfront program incremental cost.

However, the costs of this alternative in combination with limited access to funding programs make it unlikely for transit agencies to continue normal bus purchase patterns. This may result in transit agencies keeping high emitting buses longer or may result in transit agencies reducing service. Therefore, this alternative is rejected due to the high initial costs without adequate opportunity for funding.

2. Alternative Concept: Less Stringent Zero-Emission Bus Purchase Requirement

The concept of this alternative is to have a less stringent ZEB purchase requirement than the proposed ICT regulation to address the higher upfront capital cost concern. However, a less stringent ZEB purchase requirement will result in less emission reduction benefits in early years compared with the proposed purchase requirement.

In addition, it is expected that large-scale ZEB deployments can accelerate the cost reductions in ZEBs due to the economies of scale, and the maturity of the ZEB supply chain. Therefore, this alternative may not drive down the price of ZEBs as fast as the current proposal due to the volume.

3. Alternative Concept: Bus with Low-NOx Engine and Renewable Fuel Purchase Requirement

The concept of this alternative requires the purchases of low-NOx engines when new bus purchases are made, and the use of renewable fuels. It does not require the purchase of any ZEBs. Under this alternative, starting 2020, a CNG fleet is required to purchase low-NOx CNG engines when a bus purchase is made. However, there is no outlook for low-NOx diesel engines available in the near future. Using a low-NOx diesel engine in the future is not a reasonable alternative. Any additional emission reductions under this alternative would likely be attributed to other regulations that would require the use of low-NOx engines. Therefore, the use of low-NOx engines cannot provide additional emission reductions under this alternative.

Similar to the proposed ICT regulation, a large transit agency is required to use renewable fuels, including RNG and RD. To date, RNG and RD are commercially available due to the federal Renewable Fuel Standard (RFS) and California's LCFS programs. In California, RNG or RD procured by a transit agency is already under the LCFS program and receives LCFS credits. Therefore, there is no additional GHG emission reduction benefit under this alternative approach.

Furthermore, this alternative concept will not advance the adoption of heavy-duty zero-emission technologies, which is a cornerstone of California's long-term transportation strategy and has a great fuel efficiency advantage therefore potentials to reduce localized pollution and GHG emissions, and fossil fuel dependency. The costs and benefits of this proposal were evaluated in the SRIA analysis and are shown in Appendix B.

4. Alternative Concept: Performance Target Approach

CTA urged CARB to consider a performance target alternative framework[152] for achieving the goals of the proposed ICT regulation, while providing transit agencies the flexibility to implement the zero or near-zero-emission technology best-suited to meet their specific operation needs. This fleet-wide performance target approach that includes all transit modes has the potential to account for a wide range of actions to reduce NOx and GHG emissions.

CARB staff organized a TAS meeting with transit agencies in October 2016 to exclusively discuss questions that would need to be addressed to develop details of

[152] California Transit Association (CTA). Proposed Framework for Incentivizing the Adoption of Zero Emission Transit Fleets. Available: https://caltransit.org/cta/assets/File/Proposed%20Alternative%20to%20ACT%20regulation.pdf.

CTA's performance target framework. The TAS agreed that such a concept must have real emission reductions, have a practical implementation mechanism, and must be quantifiable.

During the meeting, multiple ideas about measurement metrics or emission surrogates were discussed, including ridership, passenger miles, seat miles, as well as emissions per vehicle operator, emissions per passenger miles, and emissions per seat miles. However, the meeting was inconclusive on measurement metrics for the performance target approach, because each parameter has advantages and disadvantages. For example, passenger miles can represent the service of a transit agency yet it fluctuates with economy and other external social-economic factors out of control of transit agencies, while seat mile can avoid concerns of instability, yet it does not reflect standing-passenger capacity or represent the actual ridership.

At the end of the meeting, the performance target approach subgroup tasked CTA to lead the development of the approach and CTA solicited help from CARB to develop methods as well as to identify metrics and data to quantify targets.

Based on the interpretation of transit agency discussion at the TAS meeting, CARB staff evaluated the proposed approach by using energy use per seat mile and energy use per passenger mile as GHG emission surrogate, based on the data reported to NTD. CARB staff also identified implications and questions or issues for CTA and the subgroup to discuss and consider. CARB staff then presented results and findings to TAS during two meetings over phone in January and February 2017 and solicited comments on the methodology.

At the workgroup meeting on June 26, 2017, CARB staff continued seeking feedback on the approach from CTA and the subgroup. This approach was also mentioned during the regulatory workshop on December 15, 2017. However, no comments from CTA, transit agencies, or other stakeholders have been received yet.

CARB staff believes this fleet-wide approach has numerous challenges and is not a feasible alternative due to the following reasons:

(1) First and foremost, this approach is more complicated than ZEB purchase requirements, because it has more parameters involved and it could be hard to design baselines and compliance targets with uncertainty of future projections. The complexity in concept design and reporting requirement may make the regulation difficult to enforce.
(2) Second, it is challenging to identify a mechanism that is equitable for all transit agencies. For example, large transit agencies with multiple modes other than bus mode, such as light rail, heavy rail, and trolleybus, would have more options than transit agencies who only have bus mode. For transit agencies that already

have energy efficient or low emission buses in the fleet, the requirements could be unfair if a constant percentage of emission reduction is required because transit agencies would need to make more effort than those with "dirtier" fleets.

(3) Third, this approach may be heavily influenced by exterior factors which may be out of transit agency control, such as changes of economy, urban planning, and immigration policies.

(4) Last but not the least, real emission reduction could be doubted, if emission reduction per passenger miles is achieved by increased ridership, instead of improvement in vehicle fuel efficiency or emission control technology.

5. Alternative Concept: Bus Manufacturer Sale Requirement

This alternative concept requires a percentage of bus manufacturer sales in California to be ZEBs and conventional internal combustion engine buses would need to be equipped with low-NOx engines if available. A credit-and-deficit program like the light-duty Zero Emission Vehicle regulation[153] would need be developed to assist the implementation of this alternative.

In general, this alternative does not incentivize transit agencies to purchase ZEBs and it cannot guarantee ZEB market or deployment. This alternative does not have any purchase enforcement on transit agencies who may or may not choose to buy ZEBs. Therefore, this alternative cannot provide an assurance of sufficient emission benefits. Further, the bus manufacturers may reduce the ZEB price in order to make enough sales. To recoup the cost, the bus manufacturers may raise the price for internal combustion engine buses. Therefore, transit agencies may face higher bus prices for conventional internal combustion engine buses, because bus manufacturers producing both conventional internal combustion engine buses and ZEBs are trying to increase ZEB sales and may mitigate the higher cost on ZEBs in order to keep business. Therefore, this alternative was rejected.

6. Alternative Concept: Voluntary Zero-Emission Bus Purchase

This alternative concept allows transit agencies to set their own courses in bus procurement without a statewide direction. This alternative has a focus on funding availability for ZEBs and includes coordination with other State agencies. However, this alternative does not send a strong signal to transit agencies to create an economy of scale to reduce bus prices. This alternative does not effectively advance zero-emission technologies in the other heavy-duty sectors, either, for similar reasons. This means

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[153] California Air Resources Board (CARB). Zero Emission Vehicle (ZEV) Program. Last Updated October 13, 2017. Available: https://www.arb.ca.gov/msprog/zevprog/zevprog.htm.

that this voluntary ZEB purchase alternative cannot provide long-term market benefits. Most importantly, this alternative would not guarantee emission reductions to significantly further California's air quality and climate goals and it is lacking legal requirements to effectively address the corresponding issues. Therefore, this alternative was rejected, although aspects of it were included in the waiver provisions if transit agencies deploy ZEBs ahead of requirements.

7. Alternative Concept: California Transit Association's Statewide Transit Electrification Proposal

CTA, as part of its continued dialogue with CARB, provided comments in response to the "Update on Innovative Clean Transit Discussion Document".[154] The comments contained CTA's counterproposal which included the following:

(1) Require each transit agency in the state to develop and submit an initial ZEB deployment plan to CARB by 2020 outlining how they will transition to a fully zero-emission standard transit bus fleet by 2040;
(2) Fund early deployments of ZEBs in DAC, state and federal non-attainment areas and for transit agencies that demonstrates an expertise in ZEB technologies, beginning in 2020; and
(3) Commit each transit agency to operating standard transit bus fleets that are 100 percent zero-emission by 2040, provided barriers to ZEB deployment—such as ZEB cost and performance, high electricity rates, weight, infrastructure availability and funding—have been resolved.

CTA's proposal aims to allow "ARB to impose an individualized purchase mandate on transit agencies that fail to meet the ZEB deployment targets, beginning in 2025, if those same barriers are resolved."[155]

Transit agencies' ZEB deployment would be tied to regional planning documents, such as Metropolitan Transportation Improvement Program (MTIP) or Metropolitan Transportation Plan (MTP), that specify and provide the majority of funding for regular bus purchase. However, these planning documents, especially MTIPs that normally have a focus on short-term projects, could be updated regularly based on the region's evolving priorities or change of funding amount and do not always provide as much

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[154] California Air Resources Board (2018). Update on Innovative Clean Transit (ICT) Discussion Document. March 17, 2018. Available: https://arb.ca.gov/msprog/ict/meeting/mt180327/180327ictconcept.pdf.

[155] California Transit Association (CTA) (2018). Re: Update on Innovative Clean Transit Discussion Document, April 30, 2018. Available: https://www.arb.ca.gov/lists/com-attach/10-cleantransit-ws-AGNQIlc3AAxVIQNm.pdf.

certainty as the proposed ICT regulation in terms of ZEB deployment. With a long-term goal by 2040 alone, it is challenging to guarantee emission reductions or ZEB deployment in early years, which plays an essential role to boost ZEB technologies. This approach is somewhat undefined and would present an implementation challenge to review and enforce a different requirement for each transit agency in the state. This proposal as suggested cannot effectively be enforced and has significant uncertainty with potentially diverse moving targets developed by individual transit agencies. However, elements of it were included in the reporting requirements.

8. Alternative Concept Proposed by Environmental Groups and Labor Unions to Delay Requirements

Environmental groups and labor unions, including Sierra Club California, Earth Justice, Union of Concerned Scientists, Coalition for Clean Air, Greater Los Angeles Local Union Number Eleven, International Brotherhood of Electrical Workers (IBEW) local 11 and 569, Sustainable Energy Solution: Labor Management Cooperation Committee, Jobs to Move America, and American Lung Association provided a comment letter dated April 12, 2018[156] proposing the following elements:

(1) Push back the regulation start date from 2020 to 2023 and have the following ZEB purchase requirements for all transit agencies:
   - o Start January 1, 2023, 33 percent of bus purchase must be ZEBs;
   - o Starting January 1, 2025, 66 percent of bus purchase must be ZEBs; and
   - o Starting January 1, 2027, 100 percent of bus purchase must be ZEBs.

(2) Push back cutaway bus and non-standard buses till
   - o Buses are commercially available;
   - o Buses must be successfully Altoona tested and approved HVIP eligible; and
   - o CARB conducts a total cost of ownership study for each of the major categories.

(3) A technology assessment in 2024, which is immediately after the first compliance date.

This alternative has a number of similarities to the current staff proposal. This proposal is rejected because some small transit agencies operate in rural areas and they have limited resources, yet this proposal does not allow small transit agencies additional time to learn from other deployment cases. Without a learning process for ZEB technologies, which requires more planning and training, the regulation may not be effectively implemented. This proposal may also eventually have some detrimental

[156] A letter from environmental groups and labor unions (2018). Re: Innovative Clean Transit Regulation Concept, Submitted online via CARB's Web Comment Submittal Form. April 12, 2018. Available: https://www.arb.ca.gov/lists/com-attach/4-cleantransit-ws-UzIBZFwpAAwGYwZp.pdf.

effect on small transit agencies, such as delaying replacement of buses with internal combustion engines, which would result in more emissions.

B. Required Alternatives

1. Small Business Alternative

Government Code section 11346.2(b)(4)(B) requires a description of reasonable alternatives to the regulation that would lessen any adverse impact on small business and the agency's reasons for rejecting those alternatives.

CARB staff believe that the proposed ICT regulation would not result in any unexpected direct cost on small businesses. With high demands for ZEBs due to the proposed ICT regulation, the production of ZEBs would increase which leads to benefits in various businesses, including ZEB manufacturing industries, ZEB components suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers. Some of these businesses may fall into the small business category, such as electricians, construction companies, including infrastructure installers, some ZEB manufacturers, fuel cell and battery producer, electric drivetrain parts and components suppliers.

2. Performance Standards in Place of Prescriptive Standards

Government Code section 11346.2(b)(4)(A) requires that when CARB proposes a regulation that would mandate the use of specific technologies or equipment, or prescribe specific actions or procedures, it must consider performance standards as an alternative. The proposed ICT regulation, requiring ZEBs be purchased when buses are otherwise being purchased, is a performance standard, as it does not prescribe the kind of technology that must be deployed or explicitly require the purchase of any specific buses or by a specific date.

3. Health and Safety Code section 57005 Major Regulation Alternatives

CARB estimates the proposed regulation will have an economic impact on the state’s business enterprises of more than $10 million in one or more years of implementation. CARB will evaluate alternatives submitted by stakeholders and consider whether there is a less costly alternative or combination of alternatives that would be equally as effective in achieving increments of environmental protection in full compliance with statutory mandates within the same amount of time as the proposed regulatory requirements, as required by Health and Safety Code section 57005. Staff reviewed and consolidated alternative proposals submitted to date in Chapter IX, none of which are as equally effective within the same amount of time.

X. THE SPECIFIC PURPOSE AND RATIONALE OF EACH ADOPTION, AMENDMENT, OR REPEAL

The proposed ICT regulation is designed to reduce criteria pollutants, toxic air contaminants, and GHG emissions from the public transit sector, and to reduce community and regional air pollution. The proposed ICT regulation is necessary to protect public health and to meet federal air quality standards and climate protection goals. It requires the purchase of zero-emission technologies by transit agencies to comprehensively address these multiple and complicated air quality and climate protection issues.

Buses operated by transit agencies are ideal candidates for zero-emission technologies. Transit buses are usually operated in urban centers and incorporate low speed with stop-and-go driving cycles, which are optimal for electric drivetrains and conductive to regenerative breaking.

Most importantly, experience from using zero-emission technology in buses and demonstrating its viability will benefit the market for the same technologies to be used in other heavy-duty vehicle applications. This is why ZEB and their electric drivetrains have been identified as the beachheads, or technology footholds, of medium- and heavy-duty ZEV technologies.

Staff is proposing to amend sections 2023, 2023.1, 2023.2, 2023.3, and 2023.4, title 13, California Code of Regulations, and adopt sections 2023.5, 2023.6, 2023.7, 2023.8, 2023.9, 2023.10, and 2023.11. Staff is proposing to codify these sections in new article 4.3 as the Innovative Clean Transit Regulation to more clearly convey the changes.

Section 2023. Innovative Clean Transit Regulations.

Section 2023(a). Applicability.

Summary of section 2023(a).

This section identifies the entities and the types of vehicles that are subject to the requirements of the ICT regulations and identifies entities and vehicles exempt from these requirements.

Rationale of section 2023(a).

This section is necessary to identify the applicability of these regulations.

Section 2023(b). Definitions.

Summary of section 2023(b).

This section proposes definitions to the terms used in the regulation.

Rationale of section 2023(b).

It is necessary that CARB defines terms with particular meanings under the ICT regulations in order to provide clarity.

Section 2023.1. Zero-Emission Bus Requirements.

Section 2023.1(a). Zero-Emission Bus Purchase Requirements.

Subsection 2023.1(a)(1).

Summary of subsection 2023.1(a)(1).

This subsection proposes the minimum number of ZEBs a transit agency is required to purchase or operate in each calendar year. The required minimum number of zero-emission buses are phased in and are a percentage of the total number of new buses a transit agency purchases in each calendar year. The ZEB purchase requirements differ for large and small transit agencies and start earlier for large transit agencies.

Rationale of subsection 2023.1(a)(1).

This subsection is necessary as it identifies the annual minimum number of ZEBs a transit agency should have to comply with the ZEB purchase requirement. The required ZEB percentage increases gradually with time to reflect continued technology improvements, availability of longer ranges of battery electric buses, and to allow time to expand infrastructure and train more technicians. A later starting date for small transit agencies allows them to further take advantage of available incentives and learn from experiences of large transit agencies. In addition, small transit agencies generally serve remote communities with long rural routes, so additional time provides them more opportunity to purchase longer-range battery electric buses as their technology develops further. The purchase schedule ensures transit emissions are reduced in California.

Subsection 2023.1(a)(2).

Summary of subsection 2023.1(a)(2).

This section proposes the rounding methodology for the calculation of the required minimum number of ZEBs.

Rationale of subsection 2023.1(a)(2).

A rounding methodology is necessary because the percentage calculation may not always result in a whole number. Transit agencies cannot purchase a partial bus to comply with the ZEB purchase requirements.

Subsection 2023.1(a)(3)

Summary of subsection 2023.1(a)(3).

This subsection applies the ZEB purchase requirements only to the total number of purchased new buses and specifies what should not be accounted as a purchase of a new bus.

Rationale of subsection 2023.1(a)(3).

Tying the ZEB requirements to the total number of purchased new buses is necessary because it allows the requirements to be consistent with transit agencies' normal purchase cycles.

Subsection 2023.1(a)(4).

Summary of subsection 2023.1(a)(4).

This subsection explains the required minimum number of ZEBs can be achieved by any combination of newly purchased ZEBs and existing ZEBs in the fleet and notes what is included in accounting for ZEBs in a fleet.

Rationale of subsection 2023.1(a)(4).

This subsection is necessary as it identifies how a transit agency shall achieve the required minimum number of ZEBs each year. This subsection proposes transit agencies shall achieve this number by any combination of purchase and lease of new or used ZEBs, as well as conversion of conventional internal combustion engine buses to ZEBs and use of any available ZEB bonus or zero-emission mobility credits. To recognize any early and additional purchase of ZEBs and converted buses to ZEBs, staff is proposing to consider the number of ZEBs in the fleet as well. The number of ZEBs in the fleet will be counted only once. Transit agencies shall also use any available ZEB bonus or zero-emission mobility credits, as provided in sections 2023.3 and 2023.5.

Subsections 2023.1(a)(5).

Summary of subsection 2023.1(a)(5).

This subsection specifies throughout that purchases of new buses are considered complete after buses are delivered. Buses should be delivered within 2 years from the initial date of a Notice to Proceed (which starts the performance time under the purchase agreement) to complete the purchase. This section also proposes that the transit agency may apply for an extension according to sections 2023.4(c)(1) and (2) if buses cannot be delivered within 2 years due to circumstances beyond the agency's control.

Rationale of sections 2023.1(a)(5).

This subsection is necessary to mark when a purchase is complete and will be counted under this rule. This subsection proposes a bus must be delivered within 2 years after the effective date of a Notice to Proceed to ensure that only purchases with a near term delivery date are considered and emissions reductions are achieved as expected. Any bus purchase that is initiated with a notice to proceed, but is not delivered within 2 years, is not considered a complete and valid purchase. A transit agency may request an extension, if delivery of a bus is delayed for reasons that are beyond a transit agency's control.

Subsections 2023.1(a)(6).

Summary of subsection 2023.1(a)(6).

This subsection notes that cancellation of a Notice to Proceed before the bus is delivered makes the purchase invalid.

Rationale of sections 2023.1(a)(6).

This subsection is necessary as it identifies a bus purchase that is initiated with a Notice to Proceed but is later canceled is not considered a complete and valid purchase, ensuring ZEBs are actually deployed and emissions reduced.

Subsection 2023(a)(7).

Summary of subsection 2023(a)(7).

This subsection states that transit agencies must retain the purchased ZEBs for at least five years after putting them in service. This requirement applies to buses that are purchased after December 31, 2022.

Rationale of subsection 2023(a)(7).

This subsection is necessary as it identifies which ZEBs are required to be retained and for how long in order to ensure that emissions reductions benefits are achieved. Transit agencies should retain ZEBs that are purchased on and after January 1, 2023 for the

purpose of complying with the ZEB purchase requirements. This requirement does not apply to ZEBs that are purchased before this date, purchase of used ZEBs, and conventional buses that are converted to ZEBs. Transit agencies shall continue to increase the number of ZEBs in the fleet as they purchase more buses. This subsection also avoids ZEBs purchased with the State's grant money retiring before reaching their minimum useful life[157] or being transferred to out of State.

Subsection 2023(a)(8).

Summary of subsection 2023(a)(8).

This subsection identifies when the annual compliance determination for transit agencies takes place. The compliance determination is based on minimum number of ZEBs a transit agency should have as of December 31st of each calendar year.

Rationale of subsection 2023(a)(9).

This is necessary as it identifies a date for compliance determination in each year.

Section 2023.1(b). Waiver of Initial Zero-Emission Bus Purchase Requirements.

Summary of section 2023.1(b).

This section proposes that the initial ZEB purchase requirements in calendar year 2023 and 2024 would be waived if California transit agencies collectively purchase at least 1000 and 1150 ZEBs statewide by December 31, 2020 and 2021, respectively.

Rationale of section 2023.1(b).

This section is necessary as it encourages earlier investment and compliance with regulatory requirements with the help of available funds. The waivers would also provide some large transit agencies with less ZEB infrastructure additional time to comply with regulatory requirements. Any early ZEB purchases would count towards future regulatory obligations. The target number of ZEBs to trigger the waivers are higher than the number of ZEBs that would be achieved solely under the regulatory requirements without the waivers; therefore, the waivers would also provide earlier emissions reductions benefits in addition to further flexibility for some transit agencies.

[157] Transit buses are expected to have a minimum useful life in order to qualify for federal funding. See Federal Transit Administration (FTA) Grant Management Circular 5010.1D, page IV – 17, November 2008. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/C_5010_1D_Finalpub.pdf.

Section 2023.1(c). Cutaway, Over-The-Road, Double Decker, and Articulated Buses.

Summary of section 2023.1(c).

This section proposes a later starting compliance year for types of buses that are in pre-commercialization stage, including cutaway, over-the-road, double decker, and articulated buses.

Rationale of section 2023.1(c).

This section is necessary as it avoids having purchase requirements on other types of ZEBs than standard 40-feet ZEBs, and that are currently in the pre-commercialization stage. Their purchase requirement starts from January 1, 2026 or after passing the Altoona testing and obtaining a bus testing report, whichever comes later, to ensure it applies when buses are that are eligible for funding commercially available.

Section 2023.1(d). Zero-Emission Bus Rollout Plan.

Subsection 2023.1(d)(1).

Summary of subsection 2023.1(d)(1).

This subsection proposes to require a Zero-Emission Bus Rollout Plan (Rollout Plan) for all transit agencies. The Rollout Plan describes how each transit agency is planning to achieve a full transition to zero-emission technologies by 2040, including how a transit agency will build out charging and fueling infrastructure to accommodate the deployment of ZEBs, how it provides services to disadvantage communities, as well as identifying the potential funding sources.

Rationale of subsection 2023.1(d)(1).

This subsection is necessary as it identifies the components of a Rollout Plan and will provide critical information for future planning, support, and funding needs. Individual transit agencies' Rollout Plans provide information on how transit agencies have determined the best strategy for their own unique situations. The Rollout Plans would require transit agencies to plan ahead of time, familiarize themselves with zero-emission technologies before the purchase requirements starts and to learn about potential challenges and available solutions to achieve a smooth transition. The Rollout Plans would provide the State to information about the number of buses likely to be deployed by each agency for several years, which, in turn, would help inform decisions about the need for funding and how to support transit agencies through this transition. The Rollout Plans would help utilities to learn about transit agency's infrastructural needs

during different stages of transition to support them with providing adequate charging infrastructure. This information is necessary to address barriers to implementation.

Subsection 2023.1(d)(2).

Summary of subsection 2023.1(d)(2).

This subsection proposes when a Rollout Plan shall be submitted to CARB. Large transit agencies should submit their Rollout Plan by July 1, 2020 and small transit agencies by July 1, 2023, respectively. Each Rollout Plan must be approved by transit agency governing board prior to submission to CARB.

Rationale of subsection 2023.1(d)(2).

This subsection is necessary as it identifies the timeline for when a Rollout Plan should be submitted to CARB. It balances the State's need for the information to address barriers with resource constraints at transit agencies. Small transit agencies have a smaller pool of resources with which to purchase ZEBs and invest in ZEB infrastructure. The later submittal date for small transit agencies allows them additional time to allocate resources, may reduce their planning costs, and provides opportunities to learn from the experience of large transit agencies.

Subsection 2023.1(d)(3).

Summary of subsection 2023.1(d)(3).

This subsection identifies how transit agencies within a Joint Zero-Emission Bus Group shall submit their Rollout Plan. One joint Rollout Plan may be submitted instead of each individual transit agency submitting their own Rollout Plan. The Rollout Plan must be approved by each participating transit agency's board prior to submittal to CARB.

Rationale subsection 2023.1(d)(3).

This subsection is necessary as it provides how Joint Zero-Emission Bus Groups shall comply with the Rollout Plan requirement, such that the State obtains from joint groups the information it needs for a successful program.

Section 2023.1(e).

Summary of section 2023.1(e).

This section identifies how newly established transit agencies have to comply with these regulations.

Rationale of section 2023.1(e).

This section is necessary as it identifies a newly establish transit agency should first report by March 31st of its existence and should submit a Rollout Plan within 18 months of its existence, such that the State obtains the information it needs for a successful program.

Section 2023.2. Compliance Option for Joint Zero-Emission Bus Group.

Section 2023.2(a).

Summary of section 2023.2(a).

This section proposes an option for two or more transit agencies to work together to meet the ZEB purchase requirements as a Joint Group. This section also proposes the criteria transit agencies shall meet to be eligible to participate in a Joint Group.

Rationale of section 2023.2(a).

This section is necessary as it identifies the eligibility criteria for participation in a Joint Group, which would allow multiple transit agencies to work collaboratively in order to more effectively utilize and optimize fueling and maintenance infrastructure for early deployments. Some transit agencies within the group may take the lead in providing infrastructure, maintenance, and training operators, especially in early stages of regulation's implementation. This option may smooth out the early transition phase for some transit agencies.

This section would require transit agencies forming a Joint Group to be within the same Metropolitan Planning Organization (MPO), Regional Transportation Planning Organization, air basin, air pollution control district, or at least share infrastructure because each of these provides a natural interconnection or optimization of resources. An MPO is responsible for design and implementation of long-term Regional Transportation Plans, which set transportation strategies and create a framework for project priorities within a metropolitan area's transportation system. A Regional Transportation Planning Organization, similarly, is responsible for transportation planning in non-metropolitan areas. Additionally, multiple transit agencies within the same air district (Air Pollution Control District and Air Quality Management District) may be able to secure funding through the local air district to deploy zero-emission buses. Being within the same air basin would provide at least the same emissions reduction benefits to the basin as if each transit agency would have complied with the regulation individually. Transit agencies in close proximity sharing infrastructure would provide better land use and optimization in infrastructure utilization and, as a result, would reduce their operational costs and smooth out their transition to ZEBs.

Section 2023.2(b).

Summary of section 2023.2(b).

This section identifies how a Joint Group is created and what documentation should be provided to CARB and when. A group of transit agencies that are forming a Joint Group must provide the Executive Officer of CARB one year's notice before the Joint Group compliance takes effect. The notice should include a list of all participating transit agencies, statement of intent, proposed start year and end date, and a short description of how they meet the identified eligibility criteria. The Executive Officer would approve the joint agreement provided at least one of the eligibility criteria has been met and would assign a Joint Group Number to each participating transit agency for purposes of reporting and tracking their annual reporting.

Rationale of section 2023.2(b).

This section is necessary as it identifies the procedure of creating a Joint Group. Providing at least a year's notice will help CARB and transit agencies to communicate, collaborate, and strategize their plan ahead of time to smooth out barriers. The information provided will help CARB to learn which transit agencies are working collaboratively and how these agencies are planning to comply with ZEB purchase requirements.

Subsection 2023.2(c)(1)

Summary of subsection 2023.2(c)(1).

This section proposes how the participating transit agencies in a Joint Group should comply with the ZEB purchase requirements. This subsection proposes participating transit agencies in a Joint Group should submit one Rollout Plan.

Rationale of section 2023.2(c)(1).

This section is necessary as it identifies requirements of complying with the ZEB purchase requirements as a Joint Group. Submission of one Rollout Plan for the group allows for close collaboration within the members. It may also save time and reduce costs for some transit agencies with restricted budget, time, and expertise. The joint Rollout Plan must be approved by each transit agency's board prior to submittal to CARB to ensure legitimacy, transparency, and public involvement of each community, ensuring a demonstrated commitment to its success.

Subsection 2023.2(c)(2), (4) and (5).

Summary of subsection 2023.2(c)(2), (4) and (5).

These subsections propose the minimum ZEB purchase requirements for the Joint Group and how compliance would be determined for participating transit agencies.

Participants of a Joint Group must collectively purchase and operate at least the same total number of ZEBs annually as if each transit agency were complying individually. If a Joint Group fails to comply with the ZEB purchase requirements in a given year, each participating transit agency will be evaluated for compliance individually.

Rationale of subsection 2023.2(c)(2), (4) and (5).

These subsections are necessary as they identify how the compliance for a Joint Group is evaluated. This requirement ensures the same expected emissions reductions benefits from deployment of ZEBs will be achieved in the region with potentially less infrastructure costs and better land use. These requirements also ensure shared responsibility and encourage successful collaboration within the Joint Group. They may also encourage every participating transit agency to purchase and deploy at least the minimum number of ZEBs they would be required to purchase if complying individually. To ensure large transit agencies with better resources will comply adequately in a Joint Group and the compliance burden would not be on small transit agencies, this section proposes the largest large transit agency must purchase the required minimum number of ZEBs as it would have to do if it complied individually.

Subsection 2023.2(c)(3).

Summary of subsection 2023.2(c)(3).

This subsection proposes how a request for extension or exemption should be evaluated for a Joint Group. A request for extension or exemption as described in section 2023.4 should explain why the compliance requirements cannot be met by any other participating transit agencies.

Rationale of subsection 2023.2(c)(3).

This section is necessary as it provides a Joint-Group-specific requirement for a request for extension or exemption. This requirement ensures close collaboration and avoids unnecessary ZEB extensions or exemptions for ZEB purchases that could potentially still be fulfilled by other participating transit agencies.

Section 2023.2(d)

Summary of section 2023.2(d).

This section proposes that if there is a change in Joint Group membership, the Joint Group must submit a request for membership change to CARB in writing and signed by all participating transit agencies.

Rationale of section 2023.2(d)

This section is necessary as it explains the procedure for any changes in membership for a Joint Group. Such procedures will help CARB to stay informed about any changes in the group for the purpose of compliance determination and ensure cooperation amongst members.

Section 2023.2(e).

Summary of section 2023(e).

This section proposes the reporting requirements for participating transit agencies in a Joint Group. Each participating transit agency in a Joint Group must report individually every year to demonstrate compliance.

Rationale of section 2023(e).

This section is necessary as it identifies the reporting and recordkeeping requirements for transit agencies within a Joint Group. Individual reporting allows CARB to learn about the annual bus purchases of each participating transit agency, which is necessary to determine compliance obligations and identify needs for additional resources. Individual reporting will also make auditing and compliance determinations easier for departing parties and the rest of the group.

Section 2023.3: Zero-Emission Bus Bonus Credits.

Section 2023.3(a).

Summary of section 2023.3(a).

This section proposes generation and use of bonus credits for early adoption of ZEBs. Each fuel cell electric bus that has been in the fleet as of January 1, 2018 will receive two bonus credits. Each fuel cell electric bus that is purchased later, between January 1, 2018 and December 31, 2023, will receive one bonus credit. Each battery electric buses that has been in the fleet as of January 1, 2018 will receive one bonus credit.

Rationale of section 2023.3(a).

This section is necessary as it identifies eligibility criteria for bonus credits. Bonus credits are designed to recognize early adopters of ZEB and maintain eligibility for incentive funding. Early adopters started operating ZEBs ahead of the regulatory requirements by taking more risks in deploying early technologies with higher costs. These transit agencies have been pioneers in addressing fuel cell maintenance, electric drivetrain maintenance, electricity rates, charging standards, education, training, developing new technologies, and resolving other issues. These pioneers and their experiences in addressing barriers have benefited other transit agencies and the broader market for zero-emission heavy-duty vehicles. Bonus credits for early adopters

provides them some flexibility with complying with the ZEB purchase requirements throughout the regulation and incentivizes earlier action. This section proposes to allocate higher credits to early adopters of fuel cell electric buses because these buses are more expensive, require more complex infrastructure. Additional credits are allocated to early deployment of FCEB during its pre-commercialization stage in recognition of its higher costs, to ensure early adopters of FCEB are able to remain eligible for incentives in the future.

Section 2023.3(b).

Summary of section 2023.3(b).

This section proposes how a ZEB bonus credit can be used. Each earned bonus credit shall remain available for compliance purpose of the transit agency even after the vehicle that generated it is retired from the fleet. Each bonus credit can only be used once towards determining compliance for that year. All bonus credits will expire by January 1, 2029 once the 100 percent ZEB purchase requirement starts.

Rationale of section 2023.3(b).

This section is necessary as it identifies the value of each ZEB bonus credit, how they can be used towards determining compliance, and when the credits expire. Bonus credits serve to recognize and incentivize early adoption of ZEBs and facilitate funding availability. Each bonus credit is treated the same as having one ZEB in the fleet; therefore, it effectively reduces the number of ZEBs required to be purchased for a given year. The bonus credits will expire on January 1, 2029 because by that point all new buses purchased must be ZEBs, so there is no need to incentivize their purchase.

Section 2023.3(c).

Summary of section 2023.3(c).

This section proposes a restriction on transferring bonus credits to other transit agencies, but bonus credits can still be used by transit agencies participating in a Joint Group.

Rationale of section 2023.3(c).

This section is necessary to preserve the integrity and purpose of bonus credits. Bonus credits are designed to recognize early actors that provided early emissions reductions in their regions by deploying ZEBs in early stages of pre-commercialization with higher costs and risks, and ensure they receive the benefit of increased access to incentive funding in recognition of their previous actions. Therefore, their earned ZEB bonus credits cannot be transferred to other transit agencies that provided no early

emissions reductions benefits. However, transit agencies that are participating in a Joint Group may share the credits within the Joint Group to provide some flexibility with complying collectively with the ZEB purchase requirement in a region.

Section 2023.4. Provisions for Extension or Exemption of a Zero-Emission Bus Purchase

Section 2023.4(a).

Summary of section 2023.4(a).

This section proposes that transit agencies may request an extension or exemption from the ZEB purchase requirements of section 2023.1.

Rationale of section 2023.4(a).

This section is necessary to provide some flexibility in extending or exempting the ZEB requirements for a transit agency in certain circumstances beyond their control. Requirements of this section should allow a transit agency to be excused from immediate compliance obligations and continue providing services with conventional buses and, in some circumstances, even purchase conventional buses to avoid service interruptions. These deferrals may be necessary to allow for extraordinary circumstances and because every transit agency operates under vastly different constraints with unique operational need, varied financial positions, and different fleet compositions; therefore, this section is necessary to safeguard infrastructure investments that have been made.

Section 2023.4(b).

Summary of subsection 2023.4(b).

This section proposes a timeline for transit agencies to submit their requests for extension or exemptions to the CARB Executive Officer every year by November 30.

Rationale of section 2023.4(b).

This section is necessary as it enumerates a deadline for submitting a request for extension or exemption. This submittal date provides ample time for transit agencies to put together all required documentations and for CARB staff to evaluate the circumstances with the help of provided information prior to compliance deadline of December 31st and reporting due date of March 31st.

Subsection 2023.4(c)(1).

Summary of subsection 2023.4(c)(1).

This subsection proposes a transit agency may request an extension from the requirements of section 2023.1(a)(4) if it has issued a Notice to Proceed, or has entered into a contractual agreement with a manufacturer for the production and delivery of a ZEB, conventional internal combustion engine bus, or fully converted ZEB within the 2-year timeframe, but is not going to receive the bus as scheduled due to manufacturing delays. Such transit agency will be given up to an additional year to complete the bus purchase.

Rationale of subsection 2023.4(c)(1).

This subsection is necessary to avoid penalizing a transit agency for a delayed delivery date of an ordered bus that is beyond the transit agency's control. Causes may include a large volume of bus orders, delays installing infrastructure, or issues with the manufacturer's supply chain. This subsection also necessarily identifies what documentation is required and how long a transit agency may delay the delivery requirement, which provides additional certainty and guidance to both regulated transit agencies as well as CARB.

Subsection 2023.4(c)(2).

Summary of subsection 2023.4(c)(2).

This subsection proposes a transit agency may request an extension of the requirements of section 2023.1(a)(4) if a delay in the infrastructure construction schedule forces a transit agency to postpone the bus delivery date. To avoid inconsistency between bus delivery and availability of infrastructure, a transit agency may claim an extension from CARB's Executive Officer by submitting documentation, including an official letter from the transit agency's board of directors, a licensed contractor, utility, building department, or other organization explaining the reasons for delay and estimating the delivery date of the project. Zero-emission infrastructure includes charging stations, hydrogen stations, and maintenance facilities. Causes of delay may include space limitations for new construction of ZEB infrastructure, purchase of rights-of-way for on-route charging, change of a general contractor, power supply issues from a utility, permit related issues, historical resources, or natural disaster.

Request for an extension must be submitted to the Executive Officer along with the required documentation. The Executive Officer may grant up to a one-year extension from the original expected bus delivery date. If, after one year, the needed infrastructure cannot be completed, the transit agency may apply for an exemption for the ZEB purchase that would be valid until transit's next purchase cycle. A transit agency could purchase conventional buses once this exemption is granted.

Rationale of subsection 2023.4(c)(2).

This subsection is necessary to avoid penalizing a transit agency for a delayed delivery date of an ordered bus for reasons that are beyond a transit agency's control. This subsection also identifies what documentation is required and how long a transit agency can delay the delivery requirement. This section also recognizes transit agencies may encounter situations in which a one-year extension would not be sufficient to finalize the infrastructure.

Subsection 2023.4(c)(3).

Summary of subsection 2023.4(c)(3).

This subsection proposes a transit agency may request an extension of the ZEB purchase requirements of section 2023.1(a) if available ZEBs in the market at the time of purchase cannot be placed in service to meet the daily needs of any bus in the fleet, considering their energy usage at the end of their battery warranty period. The criteria for this extension is based on miles travelled between charges of a depot-charging battery electric bus at the end of battery warranty period. When submitting a request for an extension, a transit agency should explain how ZEBs that have already been purchased were suitable and why it is not reasonable to electrify the rest of the fleet. The transit agency should also submit a monthly mileage report for each type of bus in the fleet to show their average daily usage, as well as a copy of the ZEB request for proposal and resulting bids that shows battery capacity of each bus. A transit agency may also provide empirical data of energy usage from available ZEBs operated on daily assignments in transit agency's service territory that includes, but is not limited to, battery degradation, air conditioning, passenger loading, grades, driving behavior.

The Executive Officer will review submitted information and compare the transit's required mileage with ranges of battery electric buses currently available using the Orange County Transit Cycle to determine the energy use per mile. If the transit agency's required range is higher than 80 percent of the range on battery electric buses (using the largest available battery pack at the end of battery warranty period) on this cycle, the transit agency will be granted an extension until the next purchase. If the ZEB requirement can be met at the next purchase, the transit agency would be required to purchase ZEBs regardless of the bus type being purchased.

Rationale of subsection 2023.4(c)(3).

This subsection is necessary as it avoids requiring a transit agency to purchase ZEBs that cannot meet its daily mileage need or purchase two ZEBs instead of one to provide services. This subsection also identifies what documentation is required and how long a transit agency can extend the purchase of ZEBs.

This subsection is based on battery electric buses because they are the most common type of ZEBs being used and depot charging is expected to be the most common strategy to be used. On-route battery electric buses and fuel cell electric buses can run longer daily distances, but there is higher cost associated with adding fuel cell buses or on-route chargers to a fleet that is already using a depot charging strategy, which can be avoided by this provision. It might be challenging for a transit agency to acquire a property, or to designate a location to install an on-route charging station. The range of battery electric buses increases as battery technology improves, but some types of buses, including cutaways, over-the-road buses, and articulated buses that are currently in a pre-commercialization stage may not meet the transit agency's daily mileage needs. This subsection is necessary to excuse the transit agency from immediate compliance obligations if available ZEBs cannot satisfy the transit agency's daily mileage needs, and allows the transit agency to continue providing services with conventional buses.

The Orange County Transit Cycle is a chassis dynamometer test for heavy-duty vehicles. The driving cycle of this test was developed by West Virginia University based on real bus operating data from the Orange County Transportation Authority. This test consists of urban and highway driving segments. It is an intermediate speed test cycle consisting of accelerations, decelerations and cruise operations reflective of transit bus use. This test was chosen because it has the closest driving cycle to California transit fleets.

Subsection 2023.4(c)(4).

Summary of section 2023.4(c)(4).

This subsection proposes a transit agency may request an exemption from ZEB purchase requirements under section 2023.1(a) when a required ZEB type for the applicable weight class based on GVWR is unavailable for purchase. A ZEB type is considered unavailable if it has not passed the complete Altoona bus testing and has not obtained a bus testing report, or it cannot be configured to meet the applicable requirements of the Americans with Disabilities Act (ADA). A ZEB is also considered unavailable if its purchase would result in a transit agency violating a federal, state, or local law, regulation, or ordinance. Transit agencies would be exempted from purchasing ZEB types if their physical characteristics, including the curb weight, are violating any federal, state, or local laws, regulations, or ordinances. This section identifies what documentation is required to be submitted to the CARB Executive Officer along with a request for an extension. CARB's Executive Officer will grant an extension from purchase of this type of ZEB, and the transit agency would be able to purchase conventional buses until the next new bus purchase is made.

Rationale of subsection 2023.4(c)(4).

This subsection is necessary to avoid requiring a transit agency to purchase a ZEB type for the applicable weighted class that is unavailable, ineligible for federal funds, or in some way in violation of federal or state law. A bus is not eligible to be purchased with federal funds if it has not passed the Altoona testing and not obtained a bus testing report. Transit agencies are required to comply with federal requirements of ADA to avoid penalties and to provide service to riders with disabilities. Transit agencies may request an exemption when the purchase of available ZEBs in the market would result in violations of the ADA requirements. In addition, if the purchase of a ZEB would result in a transit agency violating any federal or state or federal law or regulation, then the transit agency may submit a letter from its Board of Directors that details how the physical characteristics of the ZEB would violate state or federal regulations. This letter must include all relevant citations to state and federal regulatory code sections. This section is necessary to avoid any disruption in transit services and conflicts with federal requirements.

An approved extension would allow a transit agency to purchase conventional buses of the needed configuration until the next purchase cycle. To avoid an increase in the required minimum number of ZEBs in the given calendar year for other types of purchased buses, the exempted buses shall be excluded from the total number of new bus purchases in that year.

Subsection 2023.4(c)(5).

Summary of subsection 2023.4(c)(5).

This subsection proposes a transit agency may request an exemption from ZEB purchase requirements of section 2023.1(a) when a required ZEB type cannot be purchased due to financial hardship. A transit agency would need to declare a fiscal emergency through a public process and submit the board resolution along with the request for exemption to the CARB Executive Officer. The Executive Officer may grant an exemption from purchase requirements of this type of ZEB, and the transit agency would be able to purchase conventional buses until the next new bus purchase is made.

Rationale of subsection 2023.4(c)(5).

This subsection is necessary to provide relief for a transit agency experiencing financial hardship. An approved extension would allow a transit agency to purchase conventional buses of the needed bus type until the next purchase cycle. To avoid increases in the required minimum number of ZEBs in this calendar year for other types of purchased buses, the exempted buses shall be excluded from the total number of new bus purchases in that year. This exemption would apply only to requested and

justified types of buses. Different bus types have different prices; therefore, a transit agency in financial hardship may still be able to afford other types of ZEBs and conventional internal combustion engine buses.

Section 2023.5. Zero-Emission Mobility Option

Section 2023.5(a).

Summary of section 2023.5(a).

This section proposes the option of using a zero-emission mobility program in lieu of making a ZEB purchase to comply with ZEB purchase requirements. Eligible vehicles for this program are zero-emission with a GVWR of 14,000 lbs. or less, including bicycles.

Rationale of section 2023.5(a).

Staff is proposing the zero-emission mobility program to provide an alternative to satisfying the ZEB purchase requirements and encourage transit agencies to provide innovative zero-emission first- and last-mile connectivity to and from the core transportation system, which leads to a broader zero-emission future and addresses a more comprehensive transformation of California's transit systems. The concept complements Senate Bill 375 (SB 375) goals and regional plans by encouraging transit agencies to use zero emission vehicles when implementing mobility programs.

This section proposes that the zero-emission mobility services should either be directly-operated by a transit agency or operated by a contractor to the transit agency. When mobility services are under the control of transit agency, their operations would promote transit agency goals and could more effectively and efficiently connect people with the transportation system than is likely to be accomplished by independent mobility services.

This section proposes the zero-emission mobility program to recognize public transportation is evolving and transforming with development of technology. The ability to conveniently request, track, and pay for trips via mobile devices is changing the way people get around and interact with transit agencies and other organizations providing transportation options. The innovative zero-emission modes of mobility include, but are not limited to, bike-sharing, car-sharing, and ride-hailing; these will help reduce car ownership and personal miles traveled and increase the use of public transit, which will continue to function as a backbone of an integrated, multimodal, efficient transportation system. At the same time, the mobility programs complement bus service by enhancing urban mobility and transporting people more frequently and more efficiently. This section proposes the zero-emission mobility program to encourage transit agencies to

use zero emission vehicles when implementing innovative approaches to transport passengers, including use of private sector shared economy services, to provide better and more convenient access to existing transit systems.

This section proposes use of passenger miles provided by the zero-emission mobility program each year as a metric to determine equivalency to ZEB in the following year. Transit agencies will need to track actual passenger miles provided for each zero-emission vehicle in the program, instead of estimating or sampling, to ensure the integrity and enforceability of this regulation.

This section proposes to generate one credit for each 320,000 passenger miles per year for a large transit agency and for each 180,000 passenger miles per year for a small transit agency. The proposed annual passenger miles are based on the median of annual passenger miles per bus under the mode of MB in NTD from 2012 to 2016. Staff is proposing to use a multiplier of 3 for zero-emission passenger miles driven by bicycle to promote active transportation and because bicycles have lower passenger miles than other modes of transportation, but provide critical connections with the first- and last-miles of commuter trips.

Section 2023.5(b).

Summary of section 2023.5(b).

This section proposes the procedure to opt in and out of a zero-emission mobility option. Transit agencies that wish to opt in to the zero-emission mobility option will need to submit a written request to the CARB Executive Officer with a description of types of zero emission vehicles that are part of the program and details of how data will be collected and records will be kept. Transit agencies can opt out of the program at any time by submitting an official request along with an expected date of program termination.

Rationale to section 2023.5(b).

This section is necessary to provide how a transit agency may take advantage of the Mobility Option. This provides both the transit agencies and CARB with a clear understanding of what process is required. Submission of required documents, including vehicles information, program management, and data collection method ensures transit agencies are meeting the eligibility criteria and are not using any cutaway with GVWR of greater than 14,000 lbs. for the purpose of Zero-Emission Mobility Option, as purchase and operation of these cutaways are required under the ZEB purchase requirements.

Section 2023.5(c).

Summary of section 2023.5(c).

Staff is proposing the credits from the zero-emission mobility option should be calculated by using the total zero-emission passenger miles in each calendar year divided by 320,000 passenger miles per year for a large transit agency or divided by 180,000 passenger miles per year for a small transit agency. If the calculated number of mobility credits does not result in a whole number, the number must be rounded to the nearest integer to determine the number of credits.

Rationale to section 2023.5(c).

This subsection is necessary because it provides how mobility credits are calculated. The mobility credits resulting from these calculations will serve to provide an alternate avenue for compliance with the ZEB purchase requirement as well as encourage transit agencies to provide more zero-emission connectivity. Having multiple means of compliance better ensures that the emissions goals of the regulation will be met.

Section 2023.5(d).

Summary of section 2023.5(d).

This section proposes how mobility credits shall be used. Each credit will be treated the same as a ZEB in the fleet and will reduce the number of ZEBs required to be purchased and operated in the fleet. The credit from services provided in one year may be counted towards compliance in the following calendar year.

Rationale to section 2023.5(d).

This section necessarily explains how a mobility credit will be used for purposes of compliance. Each credit will be treated the same as a ZEB in the fleet and will reduce the number of ZEBs required to be purchased and operated in the fleet. Transit agencies should maintain at least the same zero-emission passenger miles every year to continue counting the mobility credit as a ZEB in the fleet. Otherwise, transit agencies should make up the deficit with purchase or lease of a ZEB or converting a conventional internal combustion engine bus to a ZEB. The mobility credits resulting from these calculations will serve to provide an alternate avenue for compliance with the ZEB purchase requirement as well as encourage transit agencies to provide more zero-emission connectivity. Having multiple means of compliance better ensures that the emissions goals of the regulation will be met.

Section 2023.5(e).

Summary of section 2023.5(e).

This section proposes that transit agencies approved to use this option should report annually to show the total zero-emission passenger miles from an eligible zero-emission mobility program and must meet the reporting and record keeping requirements of sections 2023.8(f) and 2023.9(c).

Rationale to section 2023.5(e).

This section is necessary as it establishes the reporting and recordkeeping requirements associated with the Zero-Emission Mobility Option. Reporting is necessary to document the annual accumulated zero-emission passenger miles of transit agencies operating the Zero-Emission Mobility Option. CARB will calculate the number of mobility credits annually based on this reported information. The recordkeeping requirements would allow for audits and verification of information reported to demonstrate compliance.

Section 2023.6. Low-NOx Engine Purchase Requirements

Section 2023.6(a).

Summary of section 2023.6(a).

This section proposes requirements for low-NOx engines should apply to all transit agencies regardless of their sizes and begin with purchases made on or after January 1, 2020 or two years after low-NOx engines becomes commercially available for the bus fuel type being purchased. This section also proposes that transit agencies should purchase a low-NOx engine that is certified to lowest level of NOx at the time of purchase.

Rationale of section 2023.6(a).

This section is necessary as it identifies the starting date of the purchase requirement of low-NOx engines and clarifies what types of low-NOx engines should be purchased. As described in section 2023.1(a)(1), the purchase requirement of ZEBs is phased in to smooth out the early transitional phase to zero-emission technologies for transit agencies. To achieve the emission reduction goal in the early stages of this transition, staff is proposing best available low-NOx engines on new conventional internal combustion engine bus purchases to achieve ozone and NOx reductions where needed most when conventional bus purchases are made. This requirement supports the State to meet the emissions reductions targets of 2023 and 2031 set by SIPs.

Currently, two CNG engines are certified to the optional NOx standard and are suitable for transit bus use: the Cummins Westport 8.9 liter ISL G natural gas engine is certified to the optional 0.02 g/bhp-hr NOx standard, which is 90 percent below the current NOx standard, and the Cummins Westport 6.7 liter ISB6.7 G natural gas engine is certified to

the optional 0.10 g/bhp-hr NOx standard, which is 50 percent below the current standard. To date, these low-NOx engines have been installed on CNG buses for either repower or new purchase. As of this writing, there are no low-NOx engines certified for diesel engines that are suitable for transits' use. Therefore, staff is proposing to waive requirements to purchase them until two years after they become available, and is not requiring transit agencies to switch fuels for purposes of compliance with this requirement. CARB is planning on a low-NOx engine regulation in the near future that would apply to all heavy-duty engines. CARB Board action on a lower NOx standard for on-road heavy-duty engines is expected in 2019 and potentially could apply to the 2023 engine year for all heavy-duty engines.

Section 2023.6(b).

Summary of section 2023.6(b).

This section proposes low-NOx engine purchase requirements should apply only to purchase of new conventional buses, except those buses that are dispatched from a facility in NOx-exempt areas.

Rationale of section 2023.6(b).

This section is necessary as it identifies which transit agencies and buses are subject to low-NOx engine purchase requirements. Buses that are dispatched from a NOx-Exempt area are excluded from these requirements because these counties or areas have made substantial progress towards cleaner air and are either in attainment or near attainment of federal standards and expected to attain the standards in the next few years. Staff is proposing best available low-NOx engines on new conventional internal combustion engine bus purchases that are planned to be dispatched from a facility outside of NOx-exempt areas to provide ozone and oxides of nitrogen reductions where needed most when conventional bus purchases are made. This requirement supports the State's efforts to meet the emissions reductions targets of 2023 and 2031 in the SIP. Staff is not requiring any conventional buses that are already in service outside of NOx-exempt area to be repowered with low-NOx engines because repowering is not a general practice for transit agencies, and its requirement may cause additional financial burdens on transit agencies and require some earlier bus replacements.

Section 2023.6(c).

Summary of section 2023.6(c).

This section identifies how the early low-NOx engine purchases or voluntary engine repowers would be considered in the regulation. These early actions would count towards future compliance obligations.

Rational of section 2023.6(c).

This section is necessary as it provides for the treatment of low-NOx engine purchases made before January 1, 2020 that remain in the fleet. This will recognize any early actions and ensure a fleet remains eligible for funding if continuing to purchase low-NOx engines. Promoting early action helps achieves the desired emissions reductions earlier.

Section 2023.6(d).

Summary of section 2023.6(d).

This section would require transit agencies that are subject to low-NOx engine purchase requirements should report their purchases and vehicle information and keep records of their purchases.

Rational of section 2023.6(d).

This section is necessary as it identifies the reporting and recordkeeping requirements associated with the low-NOx engine purchase requirement. Reporting is necessary to determine annual compliance with the regulation. Recordkeeping is required for verification of reported information.

Section 2023.7. Requirements to Use Renewable Fuels.

Section 2023.7(a).

Summary of section 2023.7(a).

This section proposes that starting January 1, 2020, all large transit agencies should purchase only renewable fuels when their fuel contracts are renewed. Small transit agencies would be exempt from the renewable fuel purchase requirement.

Rationale of section 2023.7(a).

This section supports California's existing fuel policies to reduce the carbon intensity of transportation fuels. This proposed requirement should result in little or no cost because the cost of these renewable fuels are essentially the same as the conventional fuels, as the value of credits from the federal RFS program and California's LCFS program offset the higher costs of producing the renewable fuels. This requirement would send a market signal to support the LCFS program. However, the GHG emissions benefits of using renewable natural gas or renewable diesel is due to the LCFS program and cannot be counted as new reductions in the ICT regulations because they are already required by the LCFS program.

To date, about 60 percent of California transit buses are operating CNG buses and are the primary users of renewable CNG in California. Renewable CNG producers need to sell the fuel to California fleets to earn LCFS credits. Most renewable CNG is currently produced outside California, but this proposal supports the program and contributes to State efforts to increase instate production. Renewable fuels are currently commercially available due to the federal RFS Program and CARB's LCFS Program. Today, transit agencies can procure renewable natural gas at a price equal to or lower than that of fossil natural gas due to these programs.

Renewable diesel is suitable for use without engine modification and is also available at costs to users similar to conventional diesel fuel. However, renewable diesel providers are primarily contracting with larger transit fleets and do not necessarily need to contract with smaller transit agencies to sell the renewable fuel in California and earn credits. Some smaller transit agencies have not received bids for renewable diesel and requiring the use of renewable diesel for these smaller agencies could result in higher costs for them.

Section 2023.7(b).

Summary of section 2023.7(b).

This section proposes large transit agencies that are subject to requirements to use of renewable fuels must report all new and renewed fuel contracts and keep records of their contracts.

Rational of section 2023.7(b).

This section is necessary as it identifies the reporting and recordkeeping requirements for the renewable fuel purchase requirement. Reporting is necessary to determine annual compliance with the regulation. Recordkeeping is required for verification of reported information.

Section 2023.8: Reporting Requirements for Transit Agencies.

Section 2023.8(a).

Summary of section 2023.8(a).

This section proposes every transit agency should report its fleet information annually starting from March 31, 2021, through March 31, 2050, to CARB. Transit agencies should report actions towards meeting the requirements of section 2023.1 through 2023.7 in the following year.

Rationale of section 2023.8(a).

This subsection is necessary as it identifies the starting and end date of the reporting requirements and clarifies all transit agencies should report annually. Reporting is necessary to determine annual compliance with the regulation in order to ensure the regulation's goals are being met. Recordkeeping is required for verification of reported information in case of audit.

Section 2023.8(b).

Summary of section 2023.8(b).

This section proposes that the initial reporting to determine the fleet size must be submitted by March 31, 2021, and all transit agencies must report information about their active buses as of December 31, 2017.

Rationale of section 2023.8(b).

This section is necessary to document information of active buses as of December 31, 2017, to allocate credits, begin counting buses towards potential waiver of the purchase requirements, and collect accurate fleet information for planning.

Section 2023.8(c).

Summary of section 2023.8(c).

This section proposes the information that must be reported annually, including general information about transit agencies; vehicle information on each bus purchased, owned, leased, rented, and operated; engine and propulsion related information of each new bus or used bus; and information on each purchased and converted bus, including their quantity and date of purchase or full convention.

Rationale of section 2023.8(c).

This section is necessary as it identifies the information each transit agency must report. Transit information is necessary as it provides information on location of a transit agency and its ties with a related MPO, Regional Transportation Planning Organization, or air district. Contact information of a transit agency is necessary to communicate with an agent in case of a question or issue.

Vehicle information, such as vehicle identification number (VIN), make, model, manufacture year, and length are important to verify the reported bus. Fuel type, propulsion technology type, bus type, and GVWR help to determine whether the reported bus is within the scope of the regulation and help with compliance determination. Information on bus type, length, model and chassis are necessary especially for cutaways and evaluation of an exemption or extension request. Vehicle

status (active, emergency contingency, or retired), date in service, and retirement date help with compliance determinations.

Engine and propulsion related information, including engine manufacturer, engine model, engine model year, engine family name, engine size, and engine certification are necessary for verification of conventional buses and compliance determination with purchase of low-NOx engines. Other information, including battery capacity, bus charging strategy, fuel cell system manufacturer, fuel cell system model, and fuel cell system rated power will be essential for evaluating transit agencies' request for an exemption or extension.

Information on purchase of buses along with vehicle and engine information are necessary to determine compliance with the ZEB purchase requirements. This information would be used to calculate the number of bonus credits as well.

Information on converted buses along with vehicle and engine information are also necessary to determine compliance with the ZEB purchase requirements.

Section 2023.8(d).

Summary of section 2023.8(d).

This section proposes participating transit agencies in a Joint Group should use their designated Joint Group Number when reporting annually.

Rationale of section 2023.8(d).

Joint Group Numbers allow CARB staff to verify which transit agencies in joint groups are complying with ZEB purchase requirements collectively, to track data, and determine compliance.

Section 2023.8(e).

Summary of section 2023.8(e).

This section proposes that CARB will calculate the number of bonus credits based on reported information of buses as required in section 2023.8(c).

Rationale of section 2023.8(e).

This section is necessary to describe how bonus credits will be generated by CARB based on criteria defined in section 2023.3(a) and transit agencies' reported information to CARB. Bonus credits for early adopters provide some flexibility with complying with the ZEB purchase requirements throughout the regulation and incentivizes earlier action. Staff is proposing CARB would generate and monitor their use to confirm compliance and prevent miscalculation and misuse.

Section 2023.8(f).

Summary of section 2023.8(f).

This section proposes that transit agencies operating a Zero-Emission Mobility Option must report the total accumulated zero-emission passenger miles of their eligible vehicles and bicycles annually, and CARB will calculate the number of mobility credits annually based on this reported information.

Rationale of section 2023.8(f).

This subsection is necessary as it provides additional reporting requirements for transit agencies operating a Zero-Emission Mobility Option and specifies that CARB will calculate the number of mobility credits annually. As with bonus credits, mobility credits provide flexibility with complying with the ZEB purchase requirements. Staff is proposing CARB would generate and monitor the credits to conform compliance and prevent miscalculation and misuse.

Section 2023.8(g).

Summary of section 2023.8(g).

This section proposes that transit agencies must report the general location their conventional-engine buses are dispatched from, the NOx Certification Standard, and the NOx Executive Order number for the engines.

Rationale of section 2023.8(g).

This section is necessary as it identifies a further reporting requirement for transit agencies. This information, along with required engine information in section 2023.8(c)(2)(B), helps in determining compliance with low-NOx engine purchase requirements.

Section 2023.8(h).

Summary of section 2023.8(h).

This section proposes that large transit agencies subject to the fuel purchase requirement must report fuel type, quantity of renewable and non-renewable fuel purchased, and fuel contract number and its effective date and expected or actual end date annually.

Rationale of section 2023.8(h).

This section is necessary for determining compliance with the fuel purchase requirements in section 2023.7.

Section 2023.8(i).

Summary of section 2023.8(i).

This section proposes that a report will be deemed incomplete if it does not include all of the required information.

Rationale of section 2023.8(h).

This section is necessary as it provides a predicate step to complying with the reporting requirement, to describe when and how a report will be deemed complete. Reporting is necessary to determine annual compliance with the regulation in order to ensure the regulation's goals are being met.

Section 2023.9: Record Keeping Requirements.

Section 2023.9(a).

Summary of section 2023.9(a).

This section proposes that every transit agency subject to the reporting requirements of section 2023.8 must keep records of the reported information.

Rationale of section 2023.9(a).

This section is necessary as it establishes a transit agency's recordkeeping requirements. The recordkeeping requirements would allow for verification of information reported to demonstrate compliance.

Section 2023.9(b).

Summary of section 2023.9(b).

This section proposes that transit agencies should maintain copies of all purchased, leased, rented or operated zero-emission or conventional internal combustion engine buses and identifies which documents have to be maintained. These documents include proof of purchase, such as a purchase order, down payment, or signed contract for the sale, including the bus specifications, notice to proceed, proof of bus delivery, Department of Motor Vehicles (DMV) registration records, bus purchase contracts, and more.

Rational of section 2023.9(b).

This section is necessary as it identifies which documents need to be maintained to verify reported information regarding the purchase, lease, or rent of ZEB or fully converted buses to zero-emission technologies. These documents help to verify actual

purchase, delivery, or conversion dates of buses for the purpose of demonstrating compliance with ZEB purchase requirements.

Subsection 2023.9(c).

Summary of section 2023.9(c).

This section proposes that transit agencies operating a Zero-Emission Mobility Option must maintain records of total zero-emission passenger miles generated by eligible vehicles and bicycles.

Rational of section 2023.9(c).

This section is necessary as it provides a specific recordkeeping requirement for transit agencies operating a Zero-Emission Mobility Option. The recordkeeping requirements would allow for audits and verification of information reported to demonstrate compliance.

Section 2023.9(d).

Summary of section 2023.9(d).

This section proposes that transit agencies must maintain copies of all purchase contracts for low-NOx engine purchases under section 2023.6.

Rational of section 2023.9(d).

This section is necessary as it provides a specific recordkeeping requirement for the low-NOx engine requirement. This information helps demonstrate compliance with the ZEB purchase requirements and purchase of low-NOx engines.

Section 2023.9(e).

Summary of section 2023.9(e).

This section proposes that large transit agencies must maintain records of every fuel contract that is executed on and after January 1, 2020.

Rational of section 2023.9(e).

This section is necessary as it provides a specific recordkeeping requirement for large transit agencies subject to the fuel purchase requirement. This information is necessary to demonstrate compliance with the requirements of section 2023.7 to use renewable fuels.

Section 2023.9(f).

Summary of section 2023.9(f).

This section proposes that transit agencies must make the required records available to CARB staff upon their request.

Rational of section 2023.9(f).

This section is necessary as it specifies a transit agency shall make the required records available to an agent or employee of the CARB upon request to verify reported information and for the purpose of demonstrating compliance with requirements of sections 2023.1 through 2023.8.

Section 2023.9(g).

Summary of section 2023.9(g).

This section proposes that transit agencies should keep the records until three (3) years after an affected vehicle is retired or a fuel contract ends.

Rational of section 2023.9(g).

This section helps to verify the reported information with records and actual buses in the fleet. Transit agencies are purchasing buses every other year; therefore, keeping records of vehicles through their lifetime and few years after they are retired provides complete understanding of current fleet and recently retired buses. Keeping records for 3 years after a vehicle is retired provides a good understanding of transit agencies' purchase cycles while balancing the financial burden imposed on them with records retention; keeping the documentation for a longer period would have greater costs and not provide a significantly better understanding of purchase cycles. Retaining records would allow for audits and verification of information reported to demonstrate compliance within a reasonable timeframe after a bus has been retired or a contract has ended.

Section 2023.10. Authority to Suspend, Revoke, or Modify.

Summary of section 2023.10.

This section authorizes the Executive Officer to suspend, revoke, or modify an existing zero-emission bonus or mobility credit that was obtained based on false information.

Rationale of section 2023.10.

This section is necessary to prevent against fraud and determine the number of ZEB deficit. Each revoked credit is equivalent to one required zero-emission bus the agency

has failed to purchase. A transit agency with a deficit of required ZEBs is considered to be in violation of ZEB purchase requirements.

Section 2023.11. Severability.

Summary of section 2023.11.

This section states that that if one provision of the regulations is declared invalid by a court or other authority, the remaining provisions will remain in full force and effect.

Rationale for section 2023.11.

This section is necessary because it ensures that if CARB has enacted a provision in the proposed regulatory article that is finally determined by a court to be illegal, unconstitutional, or unenforceable, the remaining regulatory provisions remain intact.

XI. JUSTIFICATION FOR ADOPTION OF REGULATIONS DIFFERENT FROM FEDERAL REGULATIONS CONTAINED IN THE CODE OF FEDERAL REGULATIONS

Currently, there is no federal requirement on the use of zero-emission technologies or low-NOx engines for transit buses.

XII. PUBLIC PROCESS FOR DEVELOPMENT OF THE PROPOSED ACTION (PRE-REGULATORY INFORMATION)

Consistent with Government Code sections 11346, subdivision (b), and 11346.45, subdivision (a), and with the Board's long-standing practice, CARB staff held public workshops and had other meetings with interested persons during the development of the proposed regulation. These informal pre-rulemaking discussions provided staff with useful information that was considered during development of the regulation that is now being proposed for formal public comment.

CARB staff developed the proposed amendments through an extensive public process. The proposed amendments were developed based on staff experience with implementing the program, Board direction through resolutions, discussions with stakeholders, and staff analysis.

The public process comprises many forms of communication dialogues with stakeholders and interested public. To further engage stakeholders, CARB also formed a workgroup comprising a wide range of stakeholders representing manufacturers, fuel providers, utilities, transit agencies and others, and is expected to meet about every two months. The workgroup also has a TAS that will focus on reviewing and exploring transit agency issues and concerns that will report to the Workgroup. Besides, two subgroups with a focus on cost and performance based approach each are also formed under the Subcommittee.

A Board hearing for informational updates was also held on February 18, 2016. The following provides a list of public meetings conducted.

A. Regulatory Workshops

- May 11, 14, and 20, 2015: First regulatory workshop discussed development of the Innovative clean transit regulations.
- Dec. 15, 2017: Second regulatory workshop discussed the development of the ICT regulatory proposal and staff provided an overview of the general rule concept.
- Jun. 13, 2018: Third public workshop to discuss the updated ICT regulatory proposal.

B. Workgroup Meetings, Technology Symposium, and Informational Meetings

All these meetings are publicly noticed and webcast to provide the maximum access to the public. All meeting materials are also posted on the program website at https://arb.ca.gov/msprog/ict/meeting.htm.

- Jan. 19, 2016: Formation of the workgroup to discuss solutions and barriers to implement zero-emission technologies.
- Jan. 29, 2016: First workgroup meeting helped transit agencies improve awareness on the progress of the ICT regulation and to share information between impacted stakeholders.
- Feb 8, 2016 Technology symposium provided transit agencies and other interested stakeholders with updated information on availability of ZEB technologies
- Apr. 7, 2016: Low carbon fuel standard overview workgroup meeting.
- Apr. 7, 2016: Second ACT workgroup discussed ICT survey, electricity rates, maintenance costs, and potential off-ramp options.
- Apr. 8, 2016: First utility workgroup discussed electric utility and transit fleet electrification giving a background on SB350, CPUC, and demand charges.
- Aug. 29, 2016: Third ACT workgroup summarized life cycle cost model, literature review for maintenance cost, and survey results.
- Oct. 4, 2016: Fourth ACT workgroup described how transit fleet can achieve emission reductions and variety of implementation strategies or methods that can meet state goals.
- Nov. 14, 2016: Heavy-duty transportation workgroup discussed electrification transportation, electrification barriers and solutions for heavy-duty fleets.
- Apr. 25, 2017: Transportation electrification workgroup meeting provided updates on utility proposals to remove barriers for

transportation electrification and continue the discussion on costs associated with electrify transit fleets.

- Jun. 26, 2017: The fifth ACT workgroup discussed latest cost information and provided an update on transportation electrification for transit agencies.

C. Transit Agency Subcommittee meetings

Throughout the process CARB staff held four TAS meetings with transit agencies from December 2015- February 2018 to discuss specific topics related to the proposed amendments. These TAS meetings provided CARB staff and transit agencies opportunities to present and discuss initial regulatory concepts and potential alternatives. These workshop dates and topics are identified here:

- Dec. 16, 2015: First TAS meeting focused on reviewing and resolving issues and concerns raised by transit agencies.
- Feb. 9, 2016: Second TAS meeting addressed cost, flexibility, and transit survey questions.
- Oct. 26, 2016: Third TAS meeting discussed total cost of ownership (TCO) analysis and alternative implementation strategies for transit agencies to achieve emissions reductions under ICT program.
- Feb. 5, 6, and 13, 2018 The fourth TAS meeting was held by CARB's staff in Maryville, Clovis, and Diamond Bar to discuss concerns about the ICT discussion document regarding range, cost, and feasibility for the proposed ICT regulation.

Each of these workshops and workgroups was announced prior to its occurrence by posting a notice to the Innovative Clean Transit website. Notice is also shared via E-mail with those on the public email service list (Innovative Clean Transit), which has 5,355 recipients. Each workgroup meeting was open to all members of the public, and was webcasted online to allow for remote participation. CARB made available documents and presentations to help stakeholders prepare for the discussions.

The public may share comments with CARB staff via E-mails, phone calls, meetings, or at meetings directly. Staff considered these comments when developing the proposed ICT regulation.

D. Materials Shared with the Public

Prior to the release of staff proposal, it is essential to engage the public with more productive dialogue through sharing date points, data analysis methodologies, literature review, concept paper, and other technical tools. Eighty-three workshop and workgroup discussion documents, analysis and tools, and materials are posted on CARB's Innovative Clean Transit Meetings and Workshop Public Meetings webpage.[158]

CARB staff publicly released a total of eight discussion documents that included workshop documents, concepts and or discussions relating to the proposed ICT regulation, eight analysis documents and tools, and nine meeting summaries related to proposed amendment topics that mandated special attention. These discussion documents and analysis and tools are identified here:

1. Discussion Documents

- May 11, 14, and 20, 2015 — Developed strategies to transition public transit bus fleets to zero-emission technologies.
- Jan 29, 2016 — Document discussed TCO, battery electric cost projections, and how carbon credits generated from LCFS can offset fuel cost.
- Feb 9, 2016 — Discussed weight requirement limits for transit buses as required by California law.
- Apr 7, 2016 — Discussed electricity costs for battery electric bus operation by overviewing electricity rate structures and electricity costs.
- Apr 7, 2016 — Developed and discussed preliminary technology off-ramp concepts for the ICT regulation.
- Apr 25, 2017 — Summarized the efficiency of battery electric vehicles when compared to conventional diesel vehicles operated in the same duty cycle.

[158] California Air Resources Board (CARB) (2018). Innovative Clean Transit Meetings and Workshops. Last Reviewed June 19, 2018. Available: https://arb.ca.gov/msprog/ict/meeting.htm.

- Dec 15, 2017 — Detailed summary provided an overview of the general rule concepts contained in the ICT proposal.
- Mar 27, 2018 — Updated document related to public comments received from the December 15, 2017 discussion document with areas focusing on the transits progress, regulation starting date, roll of incentives, overall cost, and cutaways.

2. Analysis and Tools

- Aug 29, 2016 — Described how earned LCFS credits change from year to year.
- Aug 29, 2016 — Calculator tool that helps public approximate electricity costs for BEB deployment
- Aug 29, 2016 — Literature review on battery costs and analysis of their projections to estimate the impact of future BEB purchases.
- Aug 29, 2016 — Comprehensive analysis of the TCO of conventional internal combustion engine buses compared to buses with advanced technologies.
- Oct 4, 2016 — Analysis for the total cost assumptions and data sources for standard buses.
- Jun 26, 2017 — Model tool that allows for individual fleet analysis of baseline and scenario costs.
- Jun 26, 2017 — Rate calculator tool that estimates annual electricity costs for battery electric trucks and bus deployments at a given utility meter.
- Jun 26, 2017 — Updated cost assumption and data sources document regarding the Oct 4, 2016 document.

Staff conducted a SRIA as required by the Administrative Procedure Act and received feedback and comments from DOF. The original SRIA is posted on the DOF webpage and provided in Appendix B-1. The response to DOF's comments is provided in Appendix B-2. Staff also conducted an analysis as required by CEQA and CARB's certified regulatory program. This analysis is attached to the ISOR document as Appendix C.

XIII. REFERENCES

The following documents are the technical, theoretical, or empirical studies, reports, or similar documents relied upon in proposing these regulatory amendments, identified as required by Government Code, section 11346.2, subdivision (b)(3). Additionally, each appendix References the documents upon which it relies, as required by Government Code, section 11346.2, subdivision (b)(3).

Note: Each "Explanatory Footnote" is a footnote containing explanatory discussion rather than referencing specific documents relied upon.

1. *Application of San Diego Gas & Electric Company* (U 902E) for Approval of SB 350 Transportation Electrification Proposals (Cal.P.U.C. Decision 18-05-040 May 31, 2018) No. A 17-01-020 and Related Matters A 17-01-021, 17-01-022.
2. Explanatory Footnote
3. Explanatory Footnote
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16. California Air Resources Board (CARB) (2017). Innovative Clean Transit - Cost Data and Sources. June 26, 2016. Available: https://arb.ca.gov/msprog/ict/meeting/mt170626/170626costdatasources.xlsx.

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XIV. APPENDICES

Appendix A: Proposed Regulation Order

Appendix B: Standardized Regulatory Impact Analysis (SRIA)

- Appendix B-1: Original SRIA submitted to DOF
- Appendix B-2: DOF Comments to the ICT SRIA and CARB Responses

Appendix C: Draft Environmental Analysis

Appendix D: Total Fuel Costs

Appendix E: Battery Cost for Heavy-Duty Electric Vehicles

Appendix F: Bus Cost and Projection

- Appendix F-1: Bus Price Analysis
- Appendix F-2: Bus Price Projections

Appendix G: Literature Review on Transit Bus Maintenance Cost

Appendix H: Low Carbon Fuel Standard (LCFS) Program and Examples

Appendix I: Cost Updates

Appendix J: Zero-Emission Bay Area (ZEBA) Fuel Cell Bus Demonstration Program

Appendix K: Cost Model

Appendix L: Emissions Inventory Methods and Results for the Proposed Innovative Clean Transit Regulation

Appendix M: Battery Electric Truck and Bus Charging Cost Calculator

Appendix N: Weight Requirements for Transit Buses in California